Timelines of Nearly Everything

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Abstract
This book takes readers back and forth through time and makes the past accessible to all families, students and the general reader and is an unprecedented collection of a list of events in chronological order and a wealth of informative knowledge about the rise and fall of empires, major scientific breakthroughs, groundbreaking inventions, and monumental moments about everything that has ever happened.
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Timeline of ancient history

- c. 3200 BC: Sumerian cuneiform writing system and Egyptian hieroglyphs
- 3200 BC: Newgrange built in Ireland
- 3200 BC: Cycladic culture in Greece
- 3200 BC: Norte Chico civilization begins in Peru
- 3200 BC: Rise of Proto-Elamite Civilization in Iran
- 3150 BC: First Dynasty of Egypt
- 3100 BC: Skara Brae in Scotland
- c. 3000 BC: Egyptian calendar
- c. 3000 BC: Stonehenge construction begins. In its first version, it consisted of a circular ditch and bank, with 56 wooden posts.
- c. 3000 BC: Cucuteni-Trypillian culture in Romania and Ukraine
- 3000 BC: Jiroft civilization begins in Iran
- 3000 BC: First known use of papyrus by Egyptians
- 2800 BC: Kot Diji phase of the Indus Valley Civilization begins
- 2800 BC: Longshan culture in China
- 2700 BC: Minoan Civilization ancient palace city Knossos reach 80,000 inhabitants
- 2700 BC: Rise of Elam in Iran
- 2700 BC: The Epic of Gilgamesh becomes the first written story
- 2700 BC: The Old Kingdom begins in Egypt
- 2600 BC: Oldest known surviving literature: Sumerian texts from Abu Salabikh, including the Instructions of Shuruppak and the Kesh temple hymn.
- 2600 BC: Mature Harappan phase of the Indus Valley civilization (in present-day Pakistan and India) begins
- 2600 BC: Emergence of Maya culture in the Yucatán Peninsula
- 2560 BC: King Khufu completes the Great Pyramid of Giza. The Land of Punt in the Horn of Africa first appears in Egyptian records around this time.
- 2500-1500 BC: Kerma culture in Nubia
- 2500 BC: The mammoth goes extinct.
- 2334 or 2270 BC: Akkadian Empire is founded, dating depends upon whether the Middle chronology or the Short chronology is used.
• 2250 BC: Oldest known depiction of the Staff God, the oldest image of a god to be found in the Americas.
• 2200-2100 BC: 4.2 kiloyear event: a severe aridification phase, likely connected to a Bond event, which was registered throughout most North Africa, Middle East and continental North America. Related droughts very likely caused the collapse of the Old Kingdom in Egypt and of the Akkadian Empire in Mesopotamia.
• 2200 BC: completion of Stonehenge.
• 2055 BC: The Middle Kingdom begins in Egypt
• 2000 BC: Domestication of the horse
• 1900 BC: Erlitou culture in China
• 1800 BC: alphabetic writing emerges
• 1780 BC: Oldest Record of Hammurabi's Code.
• 1700 BC: Indus Valley Civilization comes to an end but is continued by the Cemetery H culture; The beginning of Poverty Point Civilization in North America
• 1600 BC: Minoan civilization on Crete is destroyed by the Minoan eruption of Santorini island.
• 1600 BC: Mycenaean Greece
• 1600 BC: The beginning of Shang Dynasty in China, evidence of a fully developed Chinese writing system
• 1600 BC: Beginning of Hittite dominance of the Eastern Mediterranean region
• c.1550 BC: The New Kingdom begins in Egypt
• 1500 BC: Composition of the Rigveda is completed
• c.1400 BC: Oldest known song with notation
• 1400-400 BC: Olmec civilization flourishes in Pre-Columbian Mexico, during Mesoamerica's Formative period
• 1200 BC: The Hallstatt culture
• 1200-1150 BC: Bronze Age collapse in Southwestern Asia and in the Eastern Mediterranean region. This period is also the setting of the *Iliad* and the *Odyssey* epic poems (which were composed about four centuries later).
• c. 1180 BC: Disintegration of Hittite Empire
• 1100 BC: Use of Iron spreads.
• 1046 BC: The Zhou force (led by King Wu of Zhou) overthrow the last king of Shang Dynasty; Zhou Dynasty established in China
• 1000 BC: Nok culture in West Africa
• c.1000 BC: King David begins his reign as the second King of Israel, after Saul
- 970 BC: King Solomon begins his reign as third King of Israel, after David
- 890 BC: Approximate date for the composition of the *Iliad* and the *Odyssey*
- 814 BC: Foundation of Carthage by the Phoenicians in today known Tunisia
- 800 BC: Rise of Greek city-states
- 788 BC: Iron Ancient in Sungai Batu (Old Kedah)
- c.785 BC: Rise of the Kingdom of Kush
- 776 BC: First recorded Ancient Olympic Games.
- 753 BC: Founding of Rome (traditional date)
- 745 BC: Tiglath-Pileser III becomes the new king of Assyria. With time he conquers neighboring countries and turns Assyria into an empire.
- 728 BC: Rise of the Median Empire.
- 722 BC: Spring and Autumn period begins in China; Zhou Dynasty's power is diminishing; the era of the Hundred Schools of Thought.
- 700 BC: The construction of Marib Dam in Arabia Felix.
- 660 BC: Purported date of the accession of Jimmu, the mythical first Emperor of Japan.
- 653 BC: Rise of Persian Empire.
- 612 BC: An alliance between the Babylonians, Medes, and Scythians succeeds in destroying Nineveh and causing subsequent fall of the Assyrian empire.
- 600 BC: Pandyan kingdom in South India.
- 600 BC: Sixteen Maha Janapadas ("Great Realms" or "Great Kingdoms") emerge in India.
- 600 BC: Evidence of writing system appear in Oaxaca used by the Zapotec civilization.
- c. 600 BC: Rise of Sao civilisation near Lake Chad
- 563 BC: Siddhartha Gautama (Buddha), founder of Buddhism is born as a prince of the Shakya tribe, which ruled parts of Magadha, one of the Maha Janapadas.
- 551 BC: Confucius, founder of Confucianism, is born.
- 550 BC: Foundation of the Persian Empire by Cyrus the Great.
- 549 BC: Mahavira, founder of Jainism, is born.
- 546 BC: Cyrus the Great overthrows Croesus King of Lydia.
- 544 BC: Rise of Magadha as the dominant power under Bimbisara.
- 539 BC: The fall of the Babylonian Empire and liberation of the Jews by Cyrus the Great.
- 529 BC: Death of Cyrus
- 525 BC: Cambyses II of Persia conquers Egypt.
• c. 512 BC: Darius I (Darius the Great) of Persia, subjugates eastern Thrace, Macedonia submits voluntarily, and annexes Libya, Persian Empire at largest extent.
• 509 BC: Expulsion of the last King of Rome, founding of Roman Republic (traditional date).
• 508 BC: Democracy instituted at Athens
• c. 500 BC: Completion of Euclid's *Elements*
• 500 BC: Panini standardizes the grammar and morphology of Sanskrit in the text Ashtadhyayi. Panini's standardized Sanskrit is known as Classical Sanskrit.
• 500 BC: Pingala uses zero and binary numeral system
• 499 BC: King Aristagoras of Miletus incites all of Hellenic Asia Minor to rebel against the Persian Empire, beginning the Greco-Persian Wars.
• 490 BC: Greek city-states defeat Persian invasion at Battle of Marathon
• 483 BC: Death of Gautama Buddha
• 480 BC: Persian invasion of Greece by Xerxes; Battles of Thermopylae and Salamis
• 479 BC: Death of Confucius
• 475 BC: Warring States period begins in China as the Zhou king became a mere figurehead; China is annexed by regional warlords
• 470/469 BC: Birth of Socrates
• 465 BC: Murder of Xerxes
• 460 BC: Birth of Democritus
• 458 BC: *The Oresteia* by Aeschylus, the only surviving trilogy of ancient Greek plays, is performed.
• 449 BC: The Greco-Persian Wars end.
• 447 BC: Building of the Parthenon at Athens started
• 432 BC: Construction of the Parthenon is completed
• 431 BC: Beginning of the Peloponnesian war between the Greek city-states
• 429 BC: Sophocles's play *Oedipus Rex* is first performed
• 427 BC: Birth of Plato
• 424 BC: Nanda dynasty comes to power.
• 404 BC: End of the Peloponnesian War
• 400 BC: Zapotec culture flourishes around city of Monte Albán
• c. 400 BC: Rise of the Garamantes as an irrigation-based desert state in the Fezzan region of Libya
• 399 BC: Death of Socrates
• 384 BC: Birth of Aristotle
• 370 BC: Death of Democritus
• 331 BC: Alexander the Great defeats Darius III of Persia in the Battle of Gaugamela, completing his
conquest of Persia.
• 326 BC: Alexander the Great defeats Indian king Porus in the Battle of the Hydaspes River.
• 323 BC: Death of Alexander the Great at Babylon.
• 322 BC: Death of Aristotle
• 321 BC: Chandragupta Maurya overthrows the Nanda Dynasty of Magadha.
• 305 BC: Chandragupta Maurya seizes the satrapies of Paropanisadai (Kabul), Aria (Herat), Arachosia
(Qandahar) and Gedrosia (Baluchistan) from Seleucus I Nicator, the Macedonian satrap of Babylonia, in
return for 500 elephants.
• 300 BC: Sangam literature (Tamil: சங்கம், Canka ilakkiyam) period in the history of
ancient southern India (known as the Tamilakam)
• 300 BC: Chola Empire in South India
• 300 BC: Construction of the Great Pyramid of Cholula, the world’s largest pyramid by volume (the Great
Pyramid of Giza built 2560 BC Egypt stands 146.5 meters, making it 91.5 meters taller), begins in Cholula,
Puebla, Mexico.
• 273 BC: Ashoka becomes the emperor of the Mauryan Empire
• 261 BC: Kalinga war
• 257 BC: Thục Dynasty takes over Việt Nam (then Kingdom of Âu Lạc)
• 255 BC: Ashoka sends a Buddhist missionary led by his son who was Mahinda Thero (Buddhist monk) to
Sri Lanka (then Lanka) Mahinda (Buddhist monk)
• 250 BC: Rise of Parthia (Ashkâniân), the second native dynasty of ancient Persia
• 232 BC: Death of Emperor Ashoka; Decline of the Mauryan Empire
• 230 BC: Emergence of Satavahanas in South India
• 221 BC: Qin Shi Huang unifies China, end of Warring States period; marking the beginning of Imperial
rule in China which lasts until 1912. Construction of the Great Wall by the Qin Dynasty begins.
• 207 BC: Kingdom of Nan Yueh extends from Canton to North Việt Nam.
• 206 BC: Han Dynasty established in China, after the death of Qin Shi Huang; China in this period officially
becomes a Confucian state and opens trading connections with the West, i.e. the Silk Road.
• 202 BC: Scipio Africanus defeats Hannibal at Battle of Zama.
• 200 BC: El Mirador, largest early Maya city, flourishes.
• 200 BC: Paper is invented in China.
• c. 200 BC: Chera dynasty in South India.
• 185 BC: Shunga Empire founded.
• 167–160 BC: Maccabean Revolt.
• 149–146 BC: Third Punic War between Rome and Carthage. War ends with the complete destruction of Carthage, allowing Rome to conquer modern day Tunisia and Libya.
• 146 BC: Roman conquest of Greece, see Roman Greece
• 121 BC: Roman armies enter Gaul for the first time.
• 111 BC: First Chinese domination of Viêt Nam in the form of the Nanyue Kingdom.
• c. 100 BC: Chola dynasty rises in prominence.
• c. 82 BC: Burebista becomes the king of Dacia.
• 80 BC: The city of Florence is founded.
• c. 60 BC-44 BC: Burebista conquers territories from south Germany to Thrace, reaching the coast of the Aegean sea.
• 49 BC: Roman Civil War between Julius Caesar and Pompey the Great.
• 44 BC: Julius Caesar murdered by Marcus Brutus and others; End of Roman Republic; beginning of Roman Empire.
• 44 BC: Burebista is assassinated in the same year like Julius Caesar and his empire breaks into 4 and later 5 kingdoms in modern-day Romania.
• 40 BC: Roman conquest of Egypt.
• 30 BC: Cleopatra ends her reign as the last active ruler of the Ptolemaic Kingdom of Egypt.
• 27 BC: Formation of Roman Empire: Octavius is given titles of Princeps and Augustus by Roman Senate - beginning of Pax Romana. Formation of influential Praetorian Guard to provide security to Emperor.
• 18 BC: Three Kingdoms period begins in Korea. The temple of Jerusalem is reconstructed.
• 6 BC: Earliest theorized date for birth of Jesus of Nazareth. Roman succession: Gaius Caesar and Lucius Caesar groomed for the throne.
• 4 BC: Widely accepted date (Ussher) for birth of Jesus Christ.
• 9: Battle of the Teutoburg Forest, the Imperial Roman Army's bloodiest defeat.
• 14: Death of Emperor Augustus (Octavian), ascension of his adopted son Tiberius to the throne.
• 26-34: Crucifixion of Jesus Christ, exact date unknown.
• 37: Death of Emperor Tiberius, ascension of his nephew Caligula to the throne.
• 40: Rome conquers Morocco.
• 41: Emperor Caligula is assassinated by the Roman senate. His uncle Claudius succeeds him.
- 43: Rome enters Britain for the first time.
- 54: Emperor Claudius dies and is succeeded by his grand nephew Nero.
- 68: Emperor Nero commits suicide, prompting the Year of the four emperors in Rome.
- 70: Destruction of Jerusalem by the armies of Titus.
- 79: Destruction of Pompeii by the volcano Vesuvius.
- 98: After a two-year rule, Emperor Nerva dies of natural causes, his adopted son Trajan succeeds him.
- 100-940: Kingdom of Aksum in the Horn of Africa
- 106-117: Roman Empire at largest extent under Emperor Trajan after having conquered modern-day Romania, Iraq and Armenia.
- 122: Construction of Hadrian's Wall begins.
- 126: Hadrian completes the Pantheon in Rome.
- 161: Death of Antoninus Pius. His rule was the only one in which Rome did not fight in a war.
- 161: Marcus Aurelius becomes emperor of the Roman Empire.
- 180 - 181: Commodus becomes Roman Emperor.
- 192: Kingdom of Champa in Central Viêt Nam.
- 200s: The Buddhist Srivijaya Empire established in Maritime Southeast Asia.
- 220: Three Kingdoms period begins in China after the fall of Han Dynasty.
- 226: Fall of the Parthian Empire and Rise of the Sassanian Empire.
- 238: Defeat of Gordian III (238-244), Philip the Arab (244-249), and Valerian (253-260), by Shapur I of Persia, (Valerian was captured by the Persians).
- 280: Emperor Wu established Jin Dynasty providing a temporary unity of China after the devastating Three Kingdoms period.
- 285: Diocletian becomes emperor of Rome and splits the Roman Empire into Eastern and Western Empires.
- 285: Diocletian begins a large-scale persecution of Christians.
- 292: The capital of the Roman empire is officially moved from Rome to Mediolanum (modern day Milan).
- 301: Diocletian’s edict on prices
- 313: Edict of Milan declared that the Roman Empire would tolerate all forms of religious worship.
• 325: Constantine I organizes the First Council of Nicaea.
• 330: Constantinople is officially named and becomes the capital of the eastern Roman Empire.
• 335: Samudragupta becomes the emperor of the Gupta empire.
• 337: Emperor Constantine I dies, leaving his sons Constantius II, Constans I, and Constantine II as the emperors of the Roman empire.
• 350: Constantius II is left sole emperor with the death of his two brothers.
• 354: Birth of Augustine of Hippo
• 361: Constantius II dies, his cousin Julian succeeds him.
• 378: Battle of Adrianople, Roman army is defeated by the Germanic tribes.
• 380: Roman Emperor Theodosius I declares the Arian faith of Christianity heretical.
• 395: Theodosius I outlaws all religions other than Catholic Christianity.
• 406: Romans are expelled from Britain.
• 407-409: Visigoths and other Germanic tribes cross into Roman-Gaul for the first time.
• 410: Visigoths sack Rome for the first time since 390 BC.
• 415: Germanic tribes enter Spain.
• 429: Vandals enter North Africa from Spain for the first time
• 439: Vandals have conquered the land stretching from Morocco to Tunisia by this time.
• 455: Vandals sack Rome, capture Sicily and Sardinia.
• c. 455: Skandagupta repels an Indo-Hephthalite attack on India.
• 476: Romulus Augustus, last Western Roman Emperor is forced to abdicate by Odoacer, a chieftain of the Germanic Heruli; Odoacer returns the imperial regalia to Eastern Roman Emperor Zeno in Constantinople in return for the title of dux of Italy; most frequently cited date for the end of ancient history.
• 476: The Roman Empire doesn't really dissolve. The succeeding empire: Byzantine, was an extension until 1453 AD.

Timeline of environmental history

Pre-Holocene (1.5 Mya)
<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 2,588,000 BC</td>
<td>c. 12,000 BC</td>
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<tr>
<td>c. 21,000 BC</td>
<td></td>
</tr>
<tr>
<td>c. 20,000 BC</td>
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<tr>
<td>c. 19,000 BC</td>
<td></td>
</tr>
<tr>
<td>c. 20,000 BC</td>
<td>c. 12,150 BC</td>
</tr>
<tr>
<td>c. 17,000 BC</td>
<td>c. 13,000 BC</td>
</tr>
<tr>
<td>c. 13,000 BC</td>
<td></td>
</tr>
<tr>
<td>c. 12,670 BC</td>
<td>c. 12,000 BC</td>
</tr>
<tr>
<td>c. 12,340 BC</td>
<td>c. 11,140 BC</td>
</tr>
<tr>
<td>c. 12,500 BC</td>
<td>c. 10,800 BC</td>
</tr>
<tr>
<td>c. 12,150 BC</td>
<td>c. 11,140 BC</td>
</tr>
<tr>
<td>c. 12,000 BC</td>
<td>c. 11,700 BC</td>
</tr>
<tr>
<td>c. 11,700 BC</td>
<td>c. 10,800 BC</td>
</tr>
<tr>
<td>c. 13,000 BC</td>
<td>c. 11,000 BC</td>
</tr>
<tr>
<td>c. 12,000 BC</td>
<td>c. 8,000 BC</td>
</tr>
<tr>
<td>BC</td>
<td>Younger Dryas impact event suspected at either of these dates.</td>
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<td>---------------------------------</td>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>c. 10,900 BC (calibrated) or c. 8900 BC (non-calibrated)</td>
<td></td>
</tr>
<tr>
<td>c. 10,800 BC</td>
<td>Younger Dryas cold period begins.</td>
</tr>
<tr>
<td>c. 10,000 BC</td>
<td>• Preboreal period begins.</td>
</tr>
<tr>
<td></td>
<td>• World: Sea levels rise abruptly and massive inland flooding occurs due to glacier melt.</td>
</tr>
<tr>
<td></td>
<td>• Neolithic culture begins, end of most recent glaciation.</td>
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<tr>
<td></td>
<td>• First cave drawings of the Mesolithic period are made, with war scenes and religious scenes, beginnings of what became storytelling, and metamorphosed into acting.</td>
</tr>
</tbody>
</table>

### 10th millennium BC

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
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<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>c. 9700 BC</td>
<td>• Lake Agassiz reforms from glacial meltwater</td>
</tr>
<tr>
<td></td>
<td>• Bering Sea: Land bridge from Siberia to North America disappears as sea level rises. See Beringia for further information</td>
</tr>
<tr>
<td></td>
<td>• North America: Long Island becomes an island, and not just a terminal moraine, when rising waters break through on the western end of the interior lake</td>
</tr>
<tr>
<td>c. 9660 to c. 9600 BC</td>
<td>Younger Dryas cold period ends. Pleistocene ends and Holocene begins. Large amounts of previously glaciated land become habitable again. Some sources place the Younger Dryas as stretching from 10,800 BC to 9500 BC. This cool period was possibly caused by a shutdown of the North Atlantic thermohaline circulation (Gulf Stream/Jet Stream), due to flooding from Lake Agassiz as it reformed.</td>
</tr>
<tr>
<td>c. 9500 BC</td>
<td>• Ancylus Lake, part of the modern-day Baltic Sea, forms.</td>
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<tr>
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<td>• There is evidence of harvesting, though not necessarily cultivation, of wild grasses in Asia Minor about this time.</td>
</tr>
<tr>
<td></td>
<td>• End of the pre-Boreal period of European climate change.</td>
</tr>
</tbody>
</table>
- Pollen Zone IV Pre-boreal, associated with juniper, willow, birch pollen deposits.
- Neolithic era begins in Ancient Near East.
- Evidence of the earliest settlement in Jericho
- In Antarctica, long-term melting of the Antarctic ice sheets is commencing.
- Creosote bush – *Larrea tridentata* clonal colony, named "King Clone", germinates in the Mojave Desert near the Lucerne Valley in California.

c. 9270 BC  |  Greenland sees an abrupt and rapid 4 °C rise in temperatures

c. 9000 BC  |  First stone structures at Jericho built.

### 9th millennium BC

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
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</thead>
<tbody>
<tr>
<td>c. 8500 BC to 7370</td>
<td>Jericho is established as one of the oldest cities in the world sometime between 8500 BC and 7370 BC</td>
</tr>
</tbody>
</table>
| c. 8000 BC    | - Transition from Boreal period to Atlantic period  
                 - Last glacial period ends  
                 - Upper Paleolithic period ends and the Mesolithic period begins  
                 - Old Man in the Mountain formed in New Hampshire by retreating glaciers  
                 - Antarctica — long-term melting of the Antarctic ice sheets is under way.  
                 - Asia — rising sea levels caused by postglacial warming.  
                 - North America — The glaciers were receding and by 8000 BC the Wisconsin glaciation had withdrawn completely.  
                 - World — Inland flooding due to catastrophic glacier melt takes place in several regions.  
                 - Neolithic Revolution, some humans begin to switch from a hunter-gatherer existence, to agriculture |
### 8th millennium BC

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<tr>
<th>Year(s)</th>
<th>Event(s)</th>
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</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>c. 7900 BC</td>
<td>c. 7700 BC</td>
</tr>
<tr>
<td>c. 7640 BC</td>
<td></td>
</tr>
</tbody>
</table>
| c. 7500 BC |          | Mesolithic hunters reach Ireland  
|           |          | 9,500-year-old Norway spruce – *Picea abies* clonal colony named "Old Tjikko" germinates in Sweden. |
| 7500–7000 BC | 3500–3000 BC | Neolithic Subpluvial begins in northern Africa, Mesolithic period ends. Until about 5000 BC, the Sahara desert is substantially wetter than today, comparable to a savannah as part of the African humid period. |

### 7th millennium BC

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
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<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>c. 6600 BC</td>
<td></td>
</tr>
</tbody>
</table>
| c. 6500 BC |          | English Channel formed  
|           |          | Ubaid period begins in Mesopotamia  
|           |          | Chalcolithic (Copper Age) and invention of the wheel occur during this time  
|           |          | Paleolithic period ends and Neolithic period begins in China, continues to 2300 BC |
| c.6440±25 BC |          | Kurile volcano on Russia's Kamchatka Peninsula has VEI 7 eruption. It is one of the largest of the Holocene epoch |
| c. 6400 BC |          | Lake Agassiz drains into oceans for the final time, leaving Lakes Manitoba, Winnipeg, Winnipegosis, and Lake of the Woods, among others in the region, as its remnants. The draining may have caused the 8.2 kiloyear event, 200 years later |
| c. 6200 BC |          | 8.2 kiloyear event, a sudden significant cooling episode |
c. 6100 BC | The Storegga Slide, causing a megatsunami in the Norwegian Sea

| 6000 BC | • Climatic or Thermal Maximum, the warmest period in the past 125,000 years, with minimal glaciation and highest sea levels. (McEvedy)
• Rising sea levels form the Torres Strait, separate Australia from New Guinea.
• Increasing desiccation of the Sahara. End of the Saharan Pluvial period.
• Associated with Pollen Zone VI Atlantic, oak-elm woodlands, warmer and maritime climate. Modern wild fauna plus, increasingly, human introductions, associated with the spread of the Neolithic farming technologies.
• Rising sea levels from glacial retreat flood what will become the Irish Sea, separating the island of Ireland from the British Isles and Continental Europe.

| 5600 BC | According to the Black Sea deluge theory, the Black Sea floods with salt water. Some 3000 cubic miles (12,500 km³) of salt water is added, significantly expanding it and transforming it from a fresh-water landlocked lake into a salt water sea.

| 5500 BC | Beginning of the desertification of north Africa, which ultimately leads to the formation of the Sahara desert from land that was previously savannah, though it remains wetter than today. It's possible this process pushed people in the area into migrating to the region of the Nile in the east, thereby laying the groundwork for the rise of Egyptian civilization.

| 5300 BC | • Vinča script (Tārtāria tablets), among the oldest writing systems

| 5000 BC | • The Older Peron transgression, a global warm period, begins.
• Use of a sail begins. The first known picture is on an Egyptian urn found in Luxor.
• Transition from Atlantic period to Subboreal period
• Metallurgy appears

| 5000 BC | 700 BC | Megalithic Temples of Malta were created
### 5th millennium BC

<table>
<thead>
<tr>
<th>Start</th>
<th>End</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 4570 BC</td>
<td>c. 4250 BC</td>
<td>Merimde culture on the Nile River</td>
</tr>
<tr>
<td>4400 BC</td>
<td>3500 BC</td>
<td>Amratian/Naqada I culture in Predynastic Egypt</td>
</tr>
<tr>
<td>4000 BC</td>
<td>3100 BC</td>
<td>Uruk period begins in Mesopotamia</td>
</tr>
</tbody>
</table>

### 4th millennium BC

<table>
<thead>
<tr>
<th>Start</th>
<th>End</th>
<th>Event(s)</th>
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<tbody>
<tr>
<td>3900 BC</td>
<td></td>
<td>• Intense aridification triggered worldwide migration to river valleys, which might have caused changes in human behaviour.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Abrupt end of the Ubaid period.</td>
</tr>
<tr>
<td>3600 BC</td>
<td>2800 BC</td>
<td>• Climatic deterioration in Western Europe and the Sahara as the African humid period ends.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• In Europe Pollen zone VII Sub Boreal, oak and beech.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Glacial advances of the Piora oscillation, with lower economic prosperity in areas not able to irrigate in the Middle East.</td>
</tr>
<tr>
<td>3500 BC to 3000 BC</td>
<td></td>
<td>The end of the Neolithic Subpluvial era and return of extremely hot and dry conditions in the Sahara Desert, hastened by the 5.9 kiloyear event and the Piora Oscillation.</td>
</tr>
<tr>
<td>3500 BC</td>
<td>3200 BC</td>
<td>Gerzeh/Naqada II culture in Egypt</td>
</tr>
<tr>
<td>3200 BC</td>
<td>3000 BC</td>
<td>Naqada III and Protodynastic Period of Egypt</td>
</tr>
<tr>
<td>3100 BC</td>
<td>2686 BC</td>
<td>Early Dynastic Period of Egypt. The hallmarks of Ancient Egypt (art, architecture, religion) all formed during this period. This is widely assumed to be the time and place of the first writing system, the Egyptian hieroglyphs (date is disputed, some claim they were used as far back as 3200 BC, while others believe they weren't invented until the 28th century BC).</td>
</tr>
</tbody>
</table>
between 3000 BC and 2800 BC

30 km/19 mi-wide Burckle Crater is formed in Indian Ocean from a possible meteor or comet impact, possibly inspiring most flood myths.

### 3rd millennium BC

<table>
<thead>
<tr>
<th>Year(s)</th>
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<td>Start</td>
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</table>
| c. 30th century BC | • c. 3000 BC: Stonehenge begins to be built. In its first version, it consists of a circular ditch and bank, with 56 wooden posts. (*National Geographic*, June 2008).
  • Sumerian Cuneiform script, considered among the oldest writing systems, is created.                                                                                       |
| 2900 BC      | Floods at Shuruppak from horizon to horizon, with sediments in Southern Iraq, stretching as far north as Kish, and as far south as Uruk, associated with the return of heavy rains in Nineveh and a potential damming of the Karun River to run into the Tigris River. This ends the Jemdet Nasr period and ushers in the Early Dynastic Period of Mesopotamian cultures of the area. Possible association of this event with the Biblical deluge. |
| c. 2880 BC   | Germination of Prometheus (a bristlecone pine of the species Pinus longaeva), formerly the world's oldest known non-clonal organism.                                                                                                                                                                                                                                                                                                   |
| c. 2832 BC   | Germination of Methuselah (a bristlecone pine of the species Pinus longaeva), currently the world's oldest known non-clonal organism.                                                                                                                                                                                                                                                                                       |
| 2807 BC      | Suggested date for an asteroid or comet impact occurring between Africa and Antarctica, around the time of a solar eclipse on May 10, based on an analysis of flood stories. Possibly causing the Burckle crater and Fenambosy Chevron.                                                                                                                                             |
| 2650 BC      | • Sumerian epic of Gilgamesh describes vast tracts of cedar forests in what is now southern Iraq. Gilgamesh defies the gods and cuts down the forest, and in return the gods say they will curse Sumer with fire (or possibly drought). By 2100 BC, soil erosion and salt buildup have devastated agriculture. One Sumerian wrote that the "earth turned white." Civilization moved north to Babylonia and Assyria. Again, deforestation becomes a factor in the rise and subsequent fall of these civilizations.
  • Some of the first laws protecting the remaining forests decreed in Ur.                                                                                                           |
| c. 2630 BC   | 1815 BC Construction of the Egyptian pyramids.                                                                                                                                                                                                                                                                                                                                                                                        |
| 2500 BC      | Sahara becomes fully desiccated, and conditions become largely identical to those of today. Desiccation had been proceeding from 7500–6000 BC, as a result of the shift in the West geographic pole and the resulting reduction of the Indian heat pump aspect of the geohemisphere's thermodynamic system. The reduction of the Indian heat pump led to a cooling of the Sahara, which became fully desiccated by 2500 BC, and conditions became largely identical to those of today. |
African tropical monsoon belt southwards from the Sahel, and intensified by the 5.9 kiloyear event. Subsequent rates of evaporation in the region led to a drying of the Sahara, as shown by the drop in water levels in Lake Chad. Tehenu of the Sahara attempt to enter into Egypt, and there is evidence of a Nile drought in the pyramid of Unas.

2300 BC | Neolithic period ends in China.

2200 BC | Beginning of a severe centennial-scale drought in northern Africa, southwestern Asia and midcontinental North America, which very likely caused the collapse of the Old Kingdom in Egypt as well as the Akkadian Empire in Mesopotamia. This coincides with the transition from the Subboreal period to the subatlantic period.

21st century BC | Construction of the Ziggurat of Ur.

2nd millennium BC

<table>
<thead>
<tr>
<th>Year(s)</th>
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</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>c. 2000 BC</td>
<td>c. 1000 BC</td>
</tr>
<tr>
<td>1900 BC</td>
<td>The Atra-Hasis Epic describes Babylonian flood, with warnings of the consequences of human overpopulation.</td>
</tr>
<tr>
<td>Around 1600 BC</td>
<td>Minoan eruption destroys much of Santorini island, but does not destroy (contrary to what was previously believed) the Minoan civilization on Crete. This may have inspired the legend of Atlantis.</td>
</tr>
<tr>
<td>1450 BC</td>
<td>Minoan civilization in the Mediterranean declines, but scholars are divided on the cause. Possibly a volcanic eruption was the source of the catastrophe (see Minoan eruption). On the other hand, gradual deforestation may have led to materials shortages in manufacturing and shipping. Loss of timber and subsequent deterioration of its land was probably a factor in the decline of Minoan power in the late Bronze Age, according to John Perlin in <em>A Forest Journey</em>.</td>
</tr>
<tr>
<td>1206 BC</td>
<td>1187 BC</td>
</tr>
</tbody>
</table>
abandonment of peasant subsistence agriculture in favour of nomadic pastoralism in Central Anatolia, Syria and northern Mesopotamia, Palestine, the Sinai and NW Arabia.

### 1st millennium BC

<table>
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<tr>
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<tbody>
<tr>
<td>Start</td>
<td>End</td>
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</tbody>
</table>
| 800 BC  | 500 BC   | - Sub-Atlantic period in Western Europe.  
|         |          | - Pollen Zone VIII, sub-Atlantic. End of last Sea Level rise.  
|         |          | - Spread of "Celtic fields", Iron Age A, and Haalstadt Celts.  
|         |          | - Increased prosperity in Europe and the Middle East.  
| 200 BC  |          | Axial age, a revolution in thinking that we know as Philosophy, begins in China, India, and Europe, with people such as Socrates, Plato, Homer, Lao Tzu, Confucius, among others, alive at this time.  
| 753 BC  |          | Ancient Rome begins, with the founding of Rome. This marks the beginning of Classical antiquity.  
| 508 BC  |          | Democracy created in Athens, Ancient Greece  
| 356 BC  | 323 BC   | Alexander the Great  
| 269 BC  | 232 BC   | Reign of Ashoka the Great, and the beginning of propagation of Buddhism  
| c. 225 BC |          | The Sub-Atlantic period began about 225 BC (estimated on the basis of radiocarbon dating) and has been characterized by increased rainfall, cooler and more humid climates, and the dominance of beech forests. The fauna of the Sub-Atlantic is essentially modern although severely depleted by human activities. The Sub-Atlantic is correlated with pollen zone IX; sea levels have been generally regressive during this time interval, though North America is an exception.  
| c. 200 BC |          | Sri Lanka first country in the world to have a nature reserve, King Devanampiyatissa established a wildlife sanctuary  

### 1st millennium AD

### 1st century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
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</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>79 AD</td>
<td>Mount Vesuvius erupts, burying Pompeii and Herculaneum</td>
</tr>
</tbody>
</table>

### 2nd century

<table>
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<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>114</td>
<td>117</td>
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<tr>
<td>186</td>
<td></td>
</tr>
</tbody>
</table>

### 3rd century

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<th>Event(s)</th>
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<tbody>
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<td>Start</td>
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</tr>
<tr>
<td>235</td>
<td>284</td>
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</table>

### 4th century

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<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>c. 300</td>
<td></td>
</tr>
<tr>
<td>301</td>
<td></td>
</tr>
</tbody>
</table>

### 5th century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>c. 400</td>
<td>c. 800</td>
</tr>
<tr>
<td>Year(s)</td>
<td>Event(s)</td>
</tr>
<tr>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>c. 450</td>
<td>Malaria epidemic in Italy.</td>
</tr>
<tr>
<td>476</td>
<td>Fall of Rome, end of the Western Roman Empire</td>
</tr>
</tbody>
</table>

**6th century**

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
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</tr>
<tr>
<td>535</td>
<td>536</td>
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</table>

**7th century**

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
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</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>650</td>
<td></td>
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<tr>
<td>600</td>
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</table>

**8th century**

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>Dates</td>
<td>unknown</td>
</tr>
<tr>
<td>750</td>
<td></td>
</tr>
<tr>
<td>774</td>
<td>775</td>
</tr>
<tr>
<td>772</td>
<td>804</td>
</tr>
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### 9th century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>c. 850</td>
<td>Severe drought exacerbated by soil erosion causes collapse of Central American city states and the end of the Classic Maya civilization.</td>
</tr>
<tr>
<td>874</td>
<td>According to Landnámabók, the settlement of Iceland begins.</td>
</tr>
</tbody>
</table>

### 10th century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>930</td>
<td>Althing, oldest parliamentary institution in the world that is still in existence, is founded</td>
</tr>
<tr>
<td>980s</td>
<td>Greenland settled by Viking colonists from Iceland</td>
</tr>
</tbody>
</table>

### 2nd millennium

### 11th century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>985</td>
<td>1080</td>
</tr>
<tr>
<td>1006</td>
<td>SN 1006 supernova, brightest apparent magnitude stellar event in recorded history (~7.5 visual magnitude)</td>
</tr>
<tr>
<td>1054</td>
<td>SN 1054 supernova, created the Crab Nebula</td>
</tr>
<tr>
<td>1099</td>
<td>The Hodh Ech Chargui and Hodh El Gharbi Regions of southern Mauritania become desert.</td>
</tr>
</tbody>
</table>
### 12th century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>1104</td>
<td>Venice Arsenal in Venice, Italy is founded, employed 16,000 at its peak for the mass production of sailing ships in large assembly lines, hundreds of years before the industrial revolution</td>
</tr>
<tr>
<td>1150</td>
<td>Renaissance of the 12th century in Europe, blast furnace for the smelting of cast iron is imported from China</td>
</tr>
<tr>
<td>1185</td>
<td>First record of windmills in Europe</td>
</tr>
<tr>
<td>Dates</td>
<td>Nan Madol is constructed on Pohnpei in Micronesia</td>
</tr>
<tr>
<td>unknown</td>
<td></td>
</tr>
</tbody>
</table>

### 13th century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>c. 1250</td>
<td>c. 1850</td>
</tr>
<tr>
<td>1257</td>
<td>Catastrophic eruption of Samalas in Indonesia, with climate effects comparable to that of the 1815 Tambora eruption. This contributed to the cooling seen in the Little Ice Age.</td>
</tr>
<tr>
<td>end of the 13th century</td>
<td>beginning of the Renaissance era in Italy, gradually spreads throughout Europe.</td>
</tr>
</tbody>
</table>

### 14th century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start</td>
<td>End</td>
</tr>
<tr>
<td>1315</td>
<td>1317</td>
</tr>
<tr>
<td>1347</td>
<td>1350s</td>
</tr>
</tbody>
</table>
Western Settlement in Greenland abandoned, possibly due to the deteriorating climate caused by the onset of the Little Ice Age.

### 15th century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1408</td>
<td>last known recording (a wedding) of Norse settlers in Greenland</td>
</tr>
<tr>
<td>1453</td>
<td>Eruption of Kuwae in Pacific contributes to fall of Constantinople. Environmental Science is developed.</td>
</tr>
<tr>
<td>1492</td>
<td>Christopher Columbus lands in Caribbean islands, starting the Columbian Exchange, causing the Aztec Empire and Inca Empire to fall to the Spanish in the next century, as well as bringing various species of animals and plants across the Atlantic Ocean.</td>
</tr>
</tbody>
</table>

### 16th century

<table>
<thead>
<tr>
<th>Year(s)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1585</td>
<td>Roanoke Colony, now in North Carolina</td>
</tr>
<tr>
<td>1587</td>
<td>End of the 16th century, End of the Renaissance era, gradual transition towards the Baroque, Romantic, Enlightenment, and Modern eras.</td>
</tr>
</tbody>
</table>

### 17th century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1600</td>
<td>Huaynaputina erupts in South America. The explosion had effects on climate around the Northern Hemisphere (Southern hemispheric records are less complete), where 1601 was the coldest year in six</td>
</tr>
</tbody>
</table>
centuries, leading to a famine in Russia; see Russian famine of 1601–1603.

1610

It has been posited that 1610 marks the beginning of the Anthropocene, or the 'Age of Man', marking a fundamental change in the relationship between humans and the Earth system.

### 18th century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 1750</td>
<td>Beginning of Industrial Revolution, which eventually turns to use of coal and other fossil fuels to drive steam engines and other devices. Anthropogenic carbon pollution presumably increases.</td>
</tr>
<tr>
<td>1755</td>
<td>Great Lisbon earthquake occurred in the Kingdom of Portugal on Saturday, 1 November, the holiday of All Saints' Day, at around 09:40 local time; subsequent fires and a tsunami almost totally destroyed Lisbon and adjoining areas, accentuating political tensions in the kingdom and profoundly disrupting Portugal's colonial ambitions.</td>
</tr>
<tr>
<td>1770</td>
<td>Failure of the monsoons in the late 1760s contribute to the Bengal famine of 1770 where 10 million people die. This forces a change in tax policy in the British Empire, which was a cause of the American War of Independence.</td>
</tr>
<tr>
<td>1783</td>
<td>The volcano Laki erupts, emitting sufficient sulfur dioxide gas and sulphate particles to kill a majority of Iceland's livestock and cause an unusually cold winter in Europe and Western Asia.</td>
</tr>
<tr>
<td>1789</td>
<td>1793</td>
</tr>
</tbody>
</table>

### 19th century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1804</td>
<td>World human population reaches 1 billion mark.</td>
</tr>
<tr>
<td>Year(s)</td>
<td>Event(s)</td>
</tr>
<tr>
<td>---------</td>
<td>----------</td>
</tr>
<tr>
<td>1815</td>
<td>Eruption of Mt. Tambora in what is now Indonesia, largest in the 2nd millennium AD. Leads to the...</td>
</tr>
<tr>
<td>1816</td>
<td>... &quot;Year Without a Summer&quot; across North America and Europe.</td>
</tr>
<tr>
<td>1845-1857</td>
<td>Unusually wet weather in Northern Europe causes crop failures. The worst crop affected was the potato on which both Ireland (the Great Famine) and Scotland (the Highland Potato Famine) were heavily dependent. Elsewhere in Europe, the food shortages lead to civil unrest and the revolutions of 1848. Counting the Irish diaspora and the forty-eighthers, millions of Europeans emigrate to North America, South America, and Australia.</td>
</tr>
<tr>
<td>1859</td>
<td>John Tyndall discovers that some gases block infrared radiation. He suggests that changes in the concentration of these gases could bring climate change.</td>
</tr>
<tr>
<td>1883</td>
<td>Eruption of Krakatoa in Indonesia. The sound of the explosion is heard as far as Australia and China, the altered air waves causes strange colours on the sky and the volcanic gases reduce global temperatures during the following years. A disputed but vivid sunset was captured in Edvard Munch's The Scream.</td>
</tr>
<tr>
<td>1896</td>
<td>Svante Arrhenius mathematically quantifies the effects of carbon dioxide on climate change related to the Industrial Revolution and the burning of fossil fuels.</td>
</tr>
</tbody>
</table>

### 20th century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>The Galveston Hurricane of 1900 hits Galveston, Texas and reverses the city's previously rapid growth.</td>
</tr>
<tr>
<td>1906</td>
<td>San Francisco earthquake causes collapse of insurance markets and the Panic of 1907.</td>
</tr>
<tr>
<td>1908</td>
<td>Tunguska Explosion decimates a remote part of Siberia.</td>
</tr>
<tr>
<td>1914-1918</td>
<td>World War I, which involves heavy bombardment, explosions, and poison gas warfare.</td>
</tr>
<tr>
<td>1918</td>
<td>Spanish flu kills between 20 and 50 million people worldwide shortly after World War I.</td>
</tr>
<tr>
<td>1927</td>
<td>World human population reached 2 billion mark.</td>
</tr>
<tr>
<td>1939-1945</td>
<td>World War II, with heavy bombardment, genocide, and explosions. Towards the end of the war, nuclear explosion.</td>
</tr>
<tr>
<td>Year</td>
<td>Event/Development</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
</tr>
<tr>
<td>post-1945</td>
<td>Warfare occurs for the first and only time when Hiroshima and Nagasaki are bombed. Nuclear tests are performed by the United States, Soviet Union, India, Pakistan, China, North Korea, the United Kingdom, and France. Above-ground detonations continue until the Partial Test Ban Treaty is signed in 1963, causing fallout and spreading radiation around the explosion sites.</td>
</tr>
<tr>
<td>1955</td>
<td>Gilbert Plass submits his seminal article &quot;The Carbon Dioxide Theory of Climatic Change&quot;.</td>
</tr>
<tr>
<td>1957</td>
<td>Sputnik is launched, becomes first man-made object to orbit the earth, and triggers the Space Race between the United States and the Soviet Union, culminating with the first man in space in 1961, and the Moon landing, humanity's first ventures to the Moon in 1969.</td>
</tr>
<tr>
<td>1960</td>
<td>World human population reached 3 billion mark.</td>
</tr>
<tr>
<td>1964</td>
<td>World human population reached 4 billion mark.</td>
</tr>
<tr>
<td>1970s</td>
<td>Deindustrialization occurs in the Midwest and then much of the United States, as manufacturing industries (and their pollution) move to China, India, and other countries.</td>
</tr>
<tr>
<td>1980</td>
<td>Mount St. Helens erupts explosively in Washington state.</td>
</tr>
<tr>
<td>1984</td>
<td>Bhopal disaster.</td>
</tr>
<tr>
<td>1986</td>
<td>Chernobyl meltdown and explosion, contaminating surrounding area, including Pripyat.</td>
</tr>
<tr>
<td>1987</td>
<td>World human population reached 5 billion mark.</td>
</tr>
<tr>
<td>1989</td>
<td>The Montreal Protocol comes into effect, phasing out chlorofluorocarbons (CFCs) and other substances responsible for ozone depletion.</td>
</tr>
<tr>
<td>1992</td>
<td>The Earth Summit is held in Rio, attended by 192 nations.</td>
</tr>
<tr>
<td>1997</td>
<td>The Kyoto Protocol is signed, committing nations to reducing greenhouse gas emissions.</td>
</tr>
<tr>
<td>1999</td>
<td>World human population reached 6 billion mark.</td>
</tr>
</tbody>
</table>
## 3rd millennium

## 21st century

<table>
<thead>
<tr>
<th>Year(s)</th>
<th>Event(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Start</strong></td>
<td><strong>End</strong></td>
</tr>
<tr>
<td>2004</td>
<td>Earthquake causes large tsunamis in the Indian Ocean, killing nearly a quarter of a million people.</td>
</tr>
<tr>
<td>2005</td>
<td>Hurricanes Katrina, Rita, and Wilma cause widespread destruction and environmental harm to coastal communities in the US Gulf Coast region, especially the New Orleans area.</td>
</tr>
<tr>
<td>2008</td>
<td>Cyclone Nargis makes landfall over Myanmar, causing widespread destruction and killing over 130,000 people.</td>
</tr>
<tr>
<td>2010</td>
<td></td>
</tr>
</tbody>
</table>
- Earthquake in Haiti destroyed vital infrastructure and kills over 100,000 people.  
- Earthquake in Chile of a magnitude of 8.8, caused damage on many cities.  
- The eruption of the Eyjafjallajökull volcano affected activities in Europe and across the world.  
- *Deepwater Horizon* oil spill in Gulf of Mexico causes millions of barrels of oil to pollute the gulf. |
| 2011 |  
- Tsunami in Japan An earthquake and later a tsunami hit the continent on March 11, 2011. After this disaster, nuclear power plants in Japan have been releasing radiation due to damage from the earthquake.  
- World human population reached the 7 **billion mark**.  
- Tornadoes of 2011, a series of destructive and record-breaking tornado outbreaks and tornado outbreak sequences strike the heartland of the United States, killing hundreds of people, injuring scores more, and causing billions of dollars in damages, particularly in St. Louis and Joplin in Missouri, Tuscaloosa and Birmingham in Alabama, and elsewhere. |
| 2012 | Hurricane Sandy devastates the eastern third of North America, from Florida to Quebec, and from Michigan to Nova Scotia, as the largest Atlantic basin hurricane in history. |
| 2013 |  
- Typhoon Haiyan (Yolanda) ravages the central Philippines, with explosive strengthening and a record-setting wind-speed at landfall of 195 miles per hour (314 km/h).  
- A multivortex tornado touches down in El Reno, Oklahoma and grows to a record-setting width of 2.6 miles (4.2 km). |
• Minamata Convention on Mercury is signed, committing nations to reducing mercury poisoning.

2015
• A global climate change pact is agreed at the COP 21 summit, committing all countries to reduce carbon emissions for the first time.

2016
• 150 nations meeting at the UNEP summit in Rwanda agree to phase out hydrofluorocarbons (HFCs), as an extension to the Montreal Protocol.

Timeline of European exploration

15th century

• 1418 – Portuguese explorers João Gonçalves Zarco and Tristão Vaz Teixeira discover Porto Santo Island in the Madeira archipelago.
• 1419 – Gonçalves and Vaz discover the main island of Madeira.
• 1431 – Diogo de Silves discovers the Azores.
• 1434 – Gil Eanes passes Cabo de Náo and becomes the first to sail beyond Cape Bojador and return alive.
• 1444 – Dinis Dias reaches the mouth of the Senegal River.
• 1446 – The Portuguese reach the mainland peninsula of Cape Verde and the Gambia River.
• 1456 – Alvise Cadamosto and Diogo Gomes explore the Cape Verde Islands, 560 kilometres (350 mi) west of the Cape Verde peninsula.
• 1460 – Pêro de Sintra reaches Sierra Leone.
• 1470 – Cape Palmas is passed.
• 1472 – Fernão do Pó discovers the island of Bioko.
• 1473 – Lopo Gonçalves is the first European sailor to cross the Equator.
• 1474–75 – Ruy de Sequeira discovers São Tomé and Príncipe.
• 1482 – Diogo Cão reaches the Congo River, where he erects a padrão ("pillar of stone").
• 1485–86 – Cão reaches Cape Cross, where he erects his last padrão.
• 1487–92 – Pêro da Covilhã travels to Arabia, to the mouth of the Red Sea, and then eastward by sail to the Malabar Coast (visiting Calicut and Goa on the Indian subcontinent). He later sails south along the east coast of Africa, visiting the trading stations of Mombasa, Zanzibar, and Sofala; on his return journey he visits Mecca and Medina before reaching Ethiopia in search of the mythical Prester John.
1488 – Bartolomeu Dias rounds the "Cape of Storms" (Cape of Good Hope), at the southernmost tip of the African continent.

1492 – Under the patronage of the Catholic Monarchs of Spain, Italian explorer Christopher Columbus discovers the Bahamas, Cuba, and "Española" (Hispaniola), which are only later recognized as part of the New World.

1493–94 – On his second voyage to the Americas, Columbus discovers Dominica and Guadeloupe, among other islands of the Lesser Antilles, as well as Puerto Rico and Jamaica.

1497 – Under the commission of Henry VII of England, Italian explorer John Cabot discovers Newfoundland, becoming the first European to explore the coast of mainland North America since the Norse explorations of Vinland five centuries earlier.

1497–98 – Vasco da Gama sails to India and back.

1498 – On his third voyage to the Americas, Christopher Columbus discovers mainland South America.

1499 – Spanish explorer Alonso de Ojeda explores the South American mainland from about Cayenne (in modern French Guiana) to Cabo de la Vela (in modern Colombia), discovering the mouth of the Orinoco River and entering Lake Maracaibo.

1499 – Italian explorer Amerigo Vespucci discovers the mouth of the Amazon River and reaches 6°S latitude, in present-day northern Brazil.

1499 – João Fernandes Lavrador, together with Pêro de Barcelos, sight Labrador.

1499 – Gaspar and Miguel Corte-Real reach and map Greenland.

**16th century**

1500 – Vicente Yáñez Pinzón reaches the northeast coast of what today is Brazil at a cape he names "Santa Maria de la Consolación" (Cabo de Santo Agostinho) and sails fifty miles up a river he names the "Marañón" (Amazon).

1500 – Pedro Álvares Cabral makes the "official" discovery of Brazil, leading the first expedition that united Europe, America, Africa, and Asia.

1500 – João Fernandes reaches Cape Farewell, Greenland ("Terra do Lavrador", or Land of the Husbandman).

1500–02 – Gaspar and Miguel Corte Real discover and name the coasts of "Terra Verde" (likely Newfoundland) and Labrador.

1500–01 – Diogo Dias discovers Madagascar and reaches the gate of the Red Sea, the Bab-el-Mandeb Strait.

1500 – Rodrigo de Bastidas explores the Colombian coast from Cabo de la Vela to the Gulf of Urabá.
• 1501–02 – Gonçalo Coelho discovers "Rio de Janeiro" (Guanabara Bay).
• 1502–03 – On his fourth voyage to the Americas, Christopher Columbus explores the North American mainland from Guanaja off modern Honduras to the present-day border of Panama and Colombia.
• 1505 – Juan de Bermúdez discovers Bermuda.
• 1506 – Lourenço de Almeida reaches the Maldives and Sri Lanka.
• 1506 – Tristão da Cunha discovers the remote island of Tristan da Cunha in the South Atlantic Ocean.
• 1509 – Diogo Lopes de Sequeira reaches Sumatra and Malacca.
• 1511 – Duarte Fernandes leads a diplomatic mission to Ayutthaya Kingdom (Siam or Thailand).
• 1511 – Rui Nunes da Cunha leads a diplomatic mission to Pegu (Burma or Myanmar).
• 1511–12 – João de Lisboa and Estevão de Fróis discover the "Cape of Santa Maria" (Punta Del Este) in the River Plate, exploring its estuary, and traveling as far south as the Gulf of San Matias at 42°S, in present-day Uruguay and Argentina (penetrating 300 km (186 mi) "around the Gulf").
• 1511–12 – António de Abreu sails through the Strait of Malacca, between Sumatra and Bangka, and along the coasts of Java, Bali, Lombok, Sumbawa, and Flores to the "Spice Islands" (Maluku).
• 1513 – Jorge Álvares becomes the first European to reach China by sea, landing on Nei Lingding Island at the Pearl River Delta.
• 1513 – Vasco Núñez de Balboa crosses the Isthmus of Panama and reaches the Bay of San Miguel, discovering the "Mar del Sur" (Pacific Ocean).
• 1513 – Juan Ponce de León discovers "La Florida" (Florida) and the Yucatán.
• 1514–15 – António Fernandes reaches present-day Zimbabwe.
• 1515 – Gonzalo de Badajoz crosses the Isthmus of Panama at the site of Nombre de Dios, reaching as far as the interior of the Azuero Peninsula.
• 1516 – Juan Díaz de Solís explores the River Plate estuary and names it "La Mar Dulce" ("The Fresh-Water Sea").
• 1516 – Portuguese traders land in Da Nang, Champa, naming it Cochinchina (modern Vietnam).
• 1518 – Lourenço Gomes reaches Borneo.
• 1518 – Juan de Grijalva explores the Mexican coast from "Patouchan" (Champotón) to just north of the Pánuco River.
• 1519 – Hernán Cortés travels from Villa Rica de la Vera Cruz to the Aztec capital of Tenochtitlan on Lake Texcoco.
• 1519 – Alonzo Alvarez de Pineda sails around the Gulf of Mexico to the Pánuco, proving its insularity; also discovers the "Father of Waters" (the Mississippi).
• 1519 – Gaspar de Espinosa sails west along the west coasts of modern Panama and Costa Rica as far as the Gulf of Nicoya.
• 1519–22 – Ferdinand Magellan's expedition completes the first circumnavigation of the globe, exploring the coast of Patagonia and discovering and traversing the Strait of Magellan.
• 1521 – Francisco Gordillo and Pedro de Quexos find the mouth of a river they name "Rio de San Juan Bautista" (perhaps Winyah Bay at the mouth of the Pee Dee River in modern South Carolina).
• 1521 – Cristóvão Jacques explores the Plate River and discovers the Parana River, entering it for about 23 leagues (around 140 km), to near the present city of Rosario.
• 1522 – Gil González Dávila explores inland from the Gulf of Nicoya, discovering Lake Nicaragua, while his pilot Andrés Niño explores along the coast to the west, discovering the Gulf of Fonseca and perhaps reaching as far as the southwestern coast of modern Guatemala.
• 1524 – Under the commission of Francis I of France, Italian explorer Giovanni da Verrazzano explores the eastern seaboard of the present-day United States from about Cape Fear to Maine. He also discovers the mouth of the Hudson River.
• c. 1524 – Aleixo Garcia travels westward from Santa Catarina, across the Paraná River (perhaps sighting Iguazu Falls) to the Paraguay River near the site of Asunción, then across the Gran Chaco to the Andes and the Inca frontier, somewhere between Mizque and Tomina in modern Bolivia.
• 1524–25 – Francisco Pizarro and Diego de Almagro explore from Punta Piña (7°56′N) on the southern coast of Panama to the San Juan River (4°N), on the west coast of Colombia.
• 1525 – Estêvão Gomes probes Penobscot Bay, Maine.
• 1525 – The Portuguese reach "Celebes" (Sulawesi).
• 1525 – Diogo da Rocha and Gomes de Sequeira discover the Caroline Islands.
• 1526 – Alonso de Salazar discovers the Marshall Islands (Bokak Atoll).
• 1526–28 – Pizarro and his pilot Bartolomé Ruiz explore the west coast of South America from the San Juan River south to the Santa River (about 9°S), becoming the first Europeans to sight the coasts of Ecuador and Peru.
• 1526–27 – Jorge de Menezes discovers New Guinea.
• 1527–28 – Sebastian Cabot explores several hundred miles up the Paraná River, past its confluence with the Paraguay.
• 1528 – Diogo Rodrigues explores the Mascarene Islands (which he names after Pedro Mascarenhas), naming the islands of Réunion, Mauritius, and Rodrigues.
- 1528–36 – Álvar Núñez Cabeza de Vaca and three others are the only survivors of a group of several hundred colonists who travel from the coast of western Florida to the Rio Sinaloa in northern Mexico, where they encounter Spanish slavers.
- 1531 – Diego de Ordaz ascends the Orinoco to the Atures rapids, just past its confluence with the Meta.
- 1532–33 – Pizarro explores and conquers inland to Cajamarca and Cuzco.
- 1533 – Fortún Ximénez finds the tip of Baja California.
- 1534 – Jacques Cartier explores the Gulf of St. Lawrence, discovering Anticosti Island and Prince Edward Island.
- 1535 – Fray Tomás de Berlanga discovers the Galapagos Islands.
- 1535 – Cartier ascends "La Grande Rivière" or "La Rivière de Hochelaga" (the St. Lawrence River) to the village of Hochelaga (present-day Montreal).
- 1535–37 – Diego de Almagro leads an expedition from Cuzco to the south, taking the Inca highway to the southwest shore of Lake Titicaca, through the altiplano and the Salta valley to Copiapó; a detachment continues south to the Maule River. Almagro takes the coastal route back, through the Atacama Desert.
- 1539 – Francisco de Ulloa sails to the head of the Gulf of California and around Baja California to Cedros Island, establishing that Baja is a peninsula.
- 1539–43 – An expedition led by Hernando de Soto explores much of the present-day Southern United States, becoming the first to cross the Appalachians (over the Blue Ridge Mountains) and the Mississippi River.
- 1540–42 – Francisco Vásquez de Coronado travels overland from Mexico in search of the mythical Seven Cities of Cibola, only to find villages of mud and thatch in what is now the Southwestern United States. He sends out smaller parties, one of which, under García López de Cárdenas, discovers the Grand Canyon; another reports the discovery of a city of gold called Quivira (in modern Kansas), which Coronado later visits – although he finds no gold.
- 1540 – Hernando de Alarcón ascends the Colorado River to the confluence of the Gila River (near present-day Yuma, Arizona).
- 1541–42 – Francisco de Orellana sails down the length of the Amazon River.
- 1542–43 – Juan Rodriguez Cabrillo explores the coasts of modern Baja and California from Punta Baja to the Russian River, discovering the Channel Islands; after his death, his second-in-command, Bartolomé Ferrer, reaches Point Arena.
- 1542 or 1543 – Fernão Mendes Pinto, António Mota and Francisco Zeimoto reach Tanegashima, Japan.
- 1543 – Ruy López de Villalobos discovers three islands (Fais, Ulithi and Yap) in the Carolines and eight atolls (Kwajalein, Læe, Ujæe, Wotho, Likiep, Wotje, Erikub and Maloelap) in the Marshall Islands.
- 1543 – Jean Alfonce explores up the Saguenay River, believing it to be "la mer du Cattay".
- 1553 – Hugh Willoughby seeks a Northeast Passage over Russia; reaches either Kolguyev Island or Novaya Zemlya.
- 1556 – Steven Borough reaches as far as Kara Strait, between Novaya Zemlya and Vaygach Island.
- 1557–59 – Juan Fernández Ladrillero and Cortés Hojea explore the Chilean coast from Valdivia (39° 48’ S) to Canal Santa Barbara (54° S); the former passes through the western entrance of the Strait of Magellan to its eastern entrance and back.
- 1565 – Miguel López de Legazpi discovers Mejit, Ailuk and Jemo in the Marshall Islands, while his subordinate Alonso de Arellano discovers Lib in the same island group, as well as five islands (Oroluk, Chuuk, Pulap, Sorol and Ngulu) in the Caroline Islands.
- 1568 – Álvaro de Mendaña discovers the Solomon Islands.
- 1576 – Martin Frobisher discovers "Meta Incognita" ("the unknown bourne"; Baffin Island) and what he believes to be a passage to Cathay: "Frobishers Stretyes" (Frobisher Bay).
- 1577–80 – Sir Francis Drake completes the second circumnavigation of the globe.
- 1578 – Frobisher sails part way up the "Mistaken Straites" (Hudson Strait).
- 1581–82 – Yermak Timofeyevich and his men cross the Ural Mountains and reach as far as Isker on the banks of the Irtysh (near modern Tobolsk).
- 1585 – John Davis explores Davis Strait, reaching 66°40’ N; also sails up Cumberland Sound, thinking it to be a "passage to Cathay".
- 1587 – Davis sails up the west coast of Greenland as far as 72°46’ N (about modern Upernavik).
- 1589 – João da Gama reaches "Yezo" (Hokkaido).
- 1592 – Davis discovers the Falkland Islands.
- 1595 – Mendaña discovers the Marquesas.
- 1596 – Willem Barentsz discovers Spitsbergen.

17th century

- 1600–01 – Prince Miron Shakhovskoi and D. Khripunov descend the Ob to the Ob Estuary and ascend the Taz River, establishing the ostrog of Mangazeya about 161 kilometres (100 mi) to 240 kilometres (150 mi) from its mouth.
- 1602–06 – Portuguese missionary Bento de Góis travels overland from India to China, via Afghanistan and the Pamirs.
- 1605 – Ketsk serving men ascend the Ket, portage to the Yenisei, and descend it to its confluence with the Sym.
1606 – Dutch navigator Willem Janszoon discovers Australia at the mouth of the Pennefather River on the western coast of the Cape York Peninsula, exploring its coast from Badu Island south to Cape Keerweer (13°58'S).

1606 – Pedro Fernandes de Queirós discovers Espiritu Santo, the largest island in what is now the nation of Vanuatu.

1606 – Luís Vaz de Torres sails through the strait that now bears his name.

1607 – Mangazeyan promyshlenniki and traders reach the lower Yenisei, establish Turukhansk, and ascend the Lower Tunguska, while Ketsk serving men ascend the Yenisei to the Angara, which they also ascend.

1607 – Henry Hudson coasts the east coast of Greenland, naming "Hold-with-Hope" (around 73°N).

1609 – Hudson sails the Halve Maen up the Hudson River as far north as present-day Albany, New York.

1610 – Étienne Brûlé ascends the Ottawa River and reaches Lake Nipissing and Georgian Bay in Lake Huron.

1610 – Kondratiy Kurochkin leads an expedition, sailing in kochi, from Turukhansk to the mouth of the Yenisei and east to the mouth of the Pyasina on the Taymyr Peninsula.

1610 – A detachment from Mangazeya ascends the Yenisei a further 640 kilometres (400 mi) to its confluence with the Sym.

1610–11 – Hudson sails through Hudson Strait into Hudson Bay, where he overwinters in James Bay.

1611 – Mangazeyan men reach the Khatanga.

1612–13 – Thomas Button is the first to explore the western shores of Hudson Bay, where he winters in the mouth of the Nelson River; also discovers Coats and Southampton Islands.

1614 – Whalers discover Jan Mayen.

1615–16 – Étienne Brûlé sights the western shore of Lake Ontario, descends the Niagara River, explores what are now parts of modern New York and Pennsylvania, and descends the Susquehanna River to Chesapeake Bay.

1616 – Jacob Le Maire and Willem Schouten discover and name Le Maire Strait, Staten Island, and Cape Horn; also discover Tonga (Niuafo'ou, Niuatoputapu, and Tafahi), Futuna and Alofi (in modern Wallis and Futuna), and several islands in the Tuamotu (Takaroa, Takapoto, Manihi, Ahe and Rangiroa) and Bismarck Archipelagos (including New Hanover and New Ireland).

1616 – Robert Bylot and William Baffin reach 77°30’N, enter Baffin Bay, discover Smith, Jones, and Lancaster Sounds and sight the coasts of Ellesmere, Devon, and Bylot Islands.

1616 – Dirk Hartog explores some 576 kilometres (358 mi) of coastline (the coast of Western Australia from about 22° to 28° S), discovering Dirk Hartog Island and Shark Bay.

1617 – English walrus hunters sight the southern coast of "Sir Thomas Smith's Island" (Nordaustlandet).
1618 – Spanish missionary Pedro Páez is believed to be the first European to see and describe the source of the Blue Nile in Ethiopia.

1618 – Lenaert Jacobszoon discovers an "island" at 22°S (the coast of Western Australia from Point Cloates to North West Cape).

1619 – Frederick de Houtman sights the coast of Western Australia near Fremantle and sails along the coast north for over 640 kilometres (400 mi).

1620 – Mangazeyan serving men reach the Vilyuy River and descend it to its confluence with the Lena.

1621–23 – Étienne Brûlé and his companion Grenolle travel along the North Channel of Lake Huron (probably sighting Manitoulin Island) to "Grand Lac" (Lake Superior) via St. Mary's River.

1622 – The Dutch ship Leeuwin discovers land near present-day Cape Leeuwin.

1623 – Jan Carstenszoon discovers the western coast of Cape York Peninsula from Cape Keerweer to the southern mouth of the Gilbert River; while his consort Willem Joosten van Colster discovers "Arnhemsland" and "Speultsland" (modern Arnhem Land and perhaps Groote Eylandt).

1624 – António de Andrade becomes the first known European to cross the Himalayas (through the Mana Pass), reaching Tibet.

1627 – Jesuit missionaries Estêvão Cacella and João Cabral cross the Himalayas and are the first to enter Bhutan.

1627 – François Thijssen, accompanied by Pieter Nuyts, discovers over 1,609 kilometres (1,000 mi) of coastline east of Cape Leeuwin to the eastern end of the Great Australian Bight.

1628 – Cabral is the first to enter Nepal.

1628 – Gerrit Frederikszoon de Witt captain of the Vianen discovers "Witsland" about 21°S, sailing 320 kilometres (200 mi) along the coast and discovering Barrow Island and parts of the Dampier Archipelago.

1628–30 – Vasilii Bugor ascends the Upper Tunguska and portages to the upper Lena, descending it to its confluence with the Kirenga.

1631–32 – Luke Foxe and Thomas James, in separate expeditions, both circumnavigate Hudson Bay in search of a Northwest Passage; Foxe sails through the channel and into the basin now named after him to 66°47'N, while James winters in the bay named after him.

1632–33 – Pyotr Beketov descends the Lena as far as its great bend, erects the ostrog Yakutsk, and sends a detachment some 720 kilometres (450 mi) downriver (where the zimovie Zhigansk is built) and another east up the Aldan as far as the Amga (which they also ascend in search of yasak).


1633–38 – Ilya Perfiliev and Ivan Rebrov sail from Zhigansk in kochi some 800 kilometres (500 mi) downriver to the mouth of the Lena and sail along the coast east and west, reaching the mouths of the Olenyok, Yana, and Indigirka rivers.
• 1638–40 – Poznik Ivanov crosses the Verkhoyansk Range into the upper reaches of the Yana, and then portages over the Chersky Range into the Indigirka River system.

• 1639–40 – Maksim Perfiliyev ascends the Vitim River to the Tsipa, which he also ascends (until rapids force him to turn back), becoming the first Russian to enter Transbaikal.

• 1639–41 – Ivan Moskvitin ascends the Maya, portages across the Dzhugdzhur Mountains, and descends the Ulya to the Sea of Okhotsk; two groups are sent to the north and south, reaching the mouths of the Taui and Uda rivers, respectively.

• 1641 – Dmitri Zyrian discovers the Alazeya, which he ascends as far as the tree line.

• 1642–43 – Dutch explorer Abel Tasman discovers "Anthony van Diemenslandt" (Tasmania) and "Staten Landt" (New Zealand). The following year he discovers "t Eylandt Amsterdam" (Tongatapu), Fiji and New Britain.

• 1643 – Kurbat Ivanov reaches the western shores of Lake Baikal, opposite Olkhon.

• 1643 – Maarten Gerritsz Vries sails along the eastern coast of "Yezo" (Hokkaidō), between Iturup and Urup, to Sakhalin.

• 1643 – Vasilii Sychev discovers the Anabar, where he establishes the zimovie Anabarskoye.

• 1643–45 – Vassili Poyarkov crosses the Stanovoy Range and descends the Zeya to the Amur, which he follows to its mouth; from here, he coasts along the Sea of Okhotsk to the Ulya (on the way sighting the Shantar Islands).

• 1644 – Tasman maps the northern coast of Australia, connecting "Nova Guinea" (the Cape York Peninsula) with "the land of D'Eendracht" (Western Australia).

• 1644 – Mikhail Stadukhin reaches the Kolyma.

• 1644–47 – Ivan Pokhabov is the first to ascend the Angara to Lake Baikal, which he crosses to the Selenga; he later ascends it and reaches Urga (in present-day Mongolia).

• 1646 – Isaya Ignatyev reaches Chaunskaya Bay.

• 1648–49 – Semyon Deznyov sails from the Kolyma, rounds Cape Dezhnev (thus proving Asia and America are separate), and reaches the Anadyr River, which he ascends for some 563 kilometres (350 mi) (here he builds the zimovie Anadyrsk).

• 1649–51 – Yerofey Khabarov ascends the Olyokma River, crosses the northern Yablonoi Mountains, and descends the Amur to its confluence with the Songhua.

• 1650 – Stadukhin and Semen Motora travel from the Kolyma, across the Anyuyskiy Range, to Anadyrsk.

• 1651–57 – Stadukhin travels from Anadyrsk to the mouth of the Penzhina River, then west along the northern coast of the Sea of Okhotsk to Okhotsk.
• 1653–54 – Beketov ascends the Khilok, crosses the southern Yablonoi Mountains, and descends the Ingoda and Shilka rivers to the latter's confluence with the Nercha (where his men build the ostrog Nerchinsk).
• 1654 – Médard Chouart des Groseilliers explores the entire western shore of Lake Michigan.
• 1659 – Groseilliers and Pierre-Esprit Radisson explore the southern shore of Lake Superior as far west as Chequamegón Bay.
• 1661 – Jesuit missionaries Johann Grueber and Albert Dorville are the first to visit Lhasa.
• 1669 – René-Robert Cavelier, Sieur de La Salle discovers the Ohio River, descending it as far as the Falls of the Ohio near the site of modern Louisville, Kentucky.
• 1673 – French-Canadian explorer Louis Jolliet and Jesuit missionary Jacques Marquette reach the upper Mississippi River, descending it to its confluence with the Arkansas River and becoming the first Europeans to map the surrounding river valley. They also discover the Missouri River.
• 1675 – During a commercial voyage, English merchant Anthony de la Roché accidentally discovers South Georgia Island, the first ever discovery of land south of the Antarctic Convergence.
• 1682 – Robert de La Salle descends the "Rivière de Colbert" (Mississippi) to its mouth.
• 1688–89 – Jacques de Noyon discovers Rainy Lake and Lake of the Woods.
• 1690–92 – Henry Kelsey travels from York Factory southwestward, probably reaching the Saskatchewan and the headwaters of the Assiniboine, in the process becoming the first European to see the Canadian Prairies.
• 1696 – Luka Morozko travels almost halfway down the west coast of Kamchatka, reaching the Tigil River.
• 1697–99 – Vladimir Atlasov reaches as far as the Golygina River on the southwest coast of Kamchatka, from which he sights Atlasov Island; also crosses the Sredinny Range (twice), reaching Olyutorsky Gulf and the Kamchatka River.

18th century

• 1706 – Mikhail Nasedkin reaches Cape Lopatka and sights Shumshu, northernmost of the Kuril Islands.
• 1710 – Yakov Permyakov discovers Bolshoy Lyakhovsky Island.
• 1713 – Ivan Kozyrevsky reaches Shumshu and Paramushir.
• 1714 – Étienne de Veniard, Sieur de Bourgmont ascends the Missouri River as far as its confluence with the Platte River, becoming the first European to enter present-day Nebraska.
• 1720 – Pedro de Villasur travels from Santa Fe, through what is now part of southeastern Colorado, to the lower Platte in eastern Nebraska.
• 1722 – Dutch explorer Jakob Roggeveen discovers "Paasch Eiland" (Easter Island) and Tutuila and Upolu.
- 1728 – In the service of the Russian Empire, Danish explorer Vitus Bering sails through the strait that now bears his name. He also discovers and names Saint Lawrence Island.
- 1732 – Mikhail Gvozdev discovers the "Large Country" (Alaska).
- 1734 – Jean Baptiste de La Vérendrye discovers Lake Winnipeg.
- 1734–37 – Stepan Muravev and Mikhail Pavlov chart the Russian coast from Arkhangelsk to just east of the Pechora, while Stepan Malygin charts it from there to the Ob River, including the Yamal Peninsula.
- 1735–36 – Vasili Pronchishchev charts the Russian coast from the Lena west to the Khatanga.
- 1737 – Dmitry Ovtsyn charts the Russian coast from the mouth of the Ob to the Yenisei.
- 1738 – Pierre de La Vérendrye visits Mandan villages near the site of present-day Bismarck, North Dakota.
- 1738–40 – Fyodor Minin charts the Russian coast from the Yenisei to the Yerasina.
- 1739 – Jean Bouvet de Lozier discovers "Cape Circumcision" (Bouvet Island).
- 1739–41 – Dmitry Laptev charts the Russian coast from the Lena to just east of the Kolyma.
- 1741 – Bering sights Mount St. Elias, the entrance of Prince William Sound, the Alaska Peninsula (from Cape Providence to Chignik Bay) and several of the Aleutian Islands (discovering Great Sitkin, Atka, and Kiska), as well as discovering Kayak, Montague, Hinchinbrook, Sitkalidak, and the Shumagin and Commander Islands; his second-in-command, Aleksei Chirikov, sights Mounts Fairweather and Douglas and discovers Noyes and Baker Islands (both off the west coast of Prince of Wales Island), as well as Baranof, Chichagof, Kruzof, Yakobi, Kodiak, Afognak, the Aleutian Islands (Umnak, Adak, Agattu, Attu, and the Islands of Four Mountains), and the Kenai Peninsula.
- 1741–42 – Khariton Laptev and Semion Chelyuskin chart the Taymyr Peninsula, with the latter reaching Cape Chelyuskin, the northernmost point of Asia.
- 1742 – Christopher Middleton discovers Wager Bay and Repulse Bay.
- 1742–43 – Louis-Joseph Gaultier de La Vérendrye and his brother François reach the Big Horn Mountains of modern Wyoming; on their return they reach the vicinity of present-day Pierre, South Dakota.
- 1747 – Jeremiah Westall discovers Chesterfield Inlet and sails about sixty miles up it.
- 1761–62 – William Christopher sails 370 kilometres (230 mi) into Chesterfield Inlet to the western end of Baker Lake.
- 1767 – Samuel Wallis discovers "King George's Land" (Tahiti).
- 1769 – José Ortega discovers San Francisco Bay.
- 1769–70 – English explorer James Cook circumnavigates both islands of New Zealand, proving they are not part of Terra Australis Incognita. He also charts the east coast of Australia from Cape Howe to Cape York.
- 1771–72 – Samuel Hearne reaches the Coppermine, descending it to what would become known as Coronation Gulf; the following year, on his way back, he becomes the first to sight and cross Great Slave Lake.
- 1772 – Yves-Joseph de Kerguelen-Trémarec discovers the Kerguelen Islands.
- 1772 – Pedro Fages sights the Sierra Nevada.
- 1773 – Ivan Lyakhov reaches Kotelný Island.
- 1773–75 – Cook is the first to cross the Antarctic Circle, reaching 71° 10’ S, thus finally disproving the existence of Terra Australis Incognita; also discovers New Caledonia and the South Sandwich Islands.
- 1774 – Juan José Pérez Hernández explores the western coast of North America from Cape Mendocino northwards, discovering the Queen Charlotte Islands, Vancouver Island, and Dall Island.
- 1775 – Bruno de Heceta discovers the mouth of the Columbia River; his consort Juan Francisco de la Bodega y Quadra discovers Prince of Wales Island (Bucareli Bay).
- 1776 – Attempting to travel overland to Las Californias, Franciscan priests Atanasio Domínguez and Silvestre Vélez de Escalante follow the Rio Grande north to the modern state of Colorado and then travel west, discovering Utah Lake and exploring much of the Four Corners region before returning to Santa Fe.
- 1777–78 – James Cook discovers Christmas Island and Hawai‘i, and also explores the Alaskan coast as far north as Icy Cape, discovering Cook Inlet and Prince William Sound.
- 1787 – Charles William Barkley discovers the Strait of Juan de Fuca.
- 1788 – Captain Arthur Phillip arrives with The First Fleet in Botany Bay on the coast of Sydney, Australia.
- 1789 – Alexander Mackenzie descends the Mackenzie River to its mouth in the Arctic Ocean.
- 1791 – Francisco de Eliza discovers the "Canal de Nuestra Señora del Rosario" (Strait of Georgia); José María Narváez expélice up it, passing the mouth of the Fraser River and reaching as far north as Texada Island.
- 1791–95 – George Vancouver, together with William Broughton, Peter Puget, Joseph Whidbey, and James Johnstone, charts the modern states of Oregon and Washington, the coast of British Columbia, and the Alaska Panhandle, discovering Admiralty, Mitkof and Wrangell Islands in the Alexander Archipelago, as well as proving the insularity of Kuiu and Revillagigedo Islands. The expedition also charts Admiralty Inlet and Puget Sound and discovers the Chatham Islands and The Snares.
- 1792 – Spanish naval officers Dionisio Alcalá Galiano and Cayetano Valdés y Flores circumnavigate Vancouver Island, proving its insularity.
- 1792 – Jacinto Caamaño enters Clarence Strait, showing that much of the Alaska Panhandle is an archipelago and not part of the mainland, as had been presumed. He also sights the southwest coast of Revillagigedo Island.
1792–93 – Mackenzie ascends the Peace and Parsnip, crosses the Canadian Rockies to the headwaters of the Fraser, ascends the West Road River and crosses the Coast Mountains, reaching the Bella Coola, which he descends to North Bentinck Arm and Dean Channel.

1796 – Scottish explorer Mungo Park reaches the upper Niger, exploring it from Ségou to Silla.

1797–98 – George Bass explores from Cape Howe to Western Port, discovering the Bass Strait.

1798 – John Fearn discovers "Pleasant Island" (Nauru).

1798 – Francisco de Lacerda travels from Tete northwest to Lake Mweru.

1798–99 – English cartographer Matthew Flinders and George Bass circumnavigate Tasmania, proving its insularity.

19th century

1800 – James Grant discovers the Australian coastline from Cape Banks to Cape Otway.

1801–04 – A fur trading post is built on Great Bear Lake.

1802 – John Murray discovers Port Phillip Bay.

1802 – Matthew Flinders explores the coast from Fowlers Bay to Encounter Bay, discovering Spencer Gulf, Kangaroo Island, and Gulf St. Vincent.

1802 – Nicolas Baudin explores the coast from Cape Banks to Encounter Bay, where he meets Flinders.

1802–03 – Flinders circumnavigates Australia.

1805–06 – Meriwether Lewis and William Clark, from Fort Mandan, ascend the Missouri to its headwaters, cross the Continental Divide via Lemhi Pass in the Bitterroot Range to enter the present state of Idaho, and descend the Clearwater and Snake rivers to the Columbia, which they descend to its mouth; on the way back Lewis explores the Blackfoot and Sun rivers, as well as the headwaters of the Marias, while Clark travels through Bozeman Pass and descends the Yellowstone to its confluence with the Missouri.

1805–06 – Mungo Park descends the Niger as far as the Bussa rapids, where he is drowned.

1806 – Yakov Sannikov discovers New Siberia Island.

1806 – Abraham Bristow discovers the Auckland Islands.

1808 – Simon Fraser descends the Fraser River for some 800 kilometres (500 mi) to its mouth, reaching the Strait of Georgia.

1810 – Frederick Hasselborough discovers Campbell and Macquarie Islands.

1811–12 – Wilson Price Hunt discovers Union Pass in the Wind River Range and reaches the upper Snake River, while Robert Stuart discovers South Pass—his route would later become the Oregon Trail.

1819 – William Smith discovers the South Shetland Islands.

1819–20 – William Edward Parry enters Lancaster Sound and reaches Melville Island, discovering and naming Cornwallis, Bathurst, and Somerset Islands; the following year sights "Banks Land" (Banks Island).

1820 – Edward Bransfield sights the Antarctic Peninsula; also discovers northernmost islands of the South Shetlands.

1820–21 – Fabian Gottlieb von Bellingshausen discovers the northernmost islands of the South Sandwich group; following year discovers Peter I and Alexander Islands.

1821 – English naval officer John Franklin explores over 800 kilometres (500 mi) of coastline from the mouth of the Coppermine River to Point Turnagain on the Kent Peninsula.

1821 – Sealers Nathaniel Palmer and George Powell discover "Powell's Islands" (South Orkney Islands).

1821–23 – Parry explores the eastern side of the Melville Peninsula, reaching the western entrance of Fury and Hecla Strait; also explores the northern coast of Foxe Basin.

1823 – Dixon Denham, Walter Oudney, and Hugh Clapperton are the first Europeans to sight Lake Chad.

1823 – Sealer James Weddell sails to 74°15'S into "King George IV's Sea" (Weddell Sea).

1824 – Samuel Black ascends the Finlay to Thutade Lake, source of the Finlay-Peace-Slave-Mackenzie river system, then portages to the Stikine and Turnagain.

1824–25 – Étienne Provost, Jim Bridger, and Peter Skene Ogden independently reach the Great Salt Lake.

1825–26 – Franklin explores the Arctic coastline from the mouth of the Mackenzie River west to Point Beechey, while his partner John Richardson explores east to the Coppermine River, naming Dolphin and Union Strait and discovering "Wollaston Land" (part of the southern coast of Victoria Island) — combining to chart over 1,930 kilometres (1,200 mi) of coastline; Richardson also surveys the five arms of Great Bear Lake.

1826 – Frederick William Beechey charts the Alaskan coastline from Icy Cape to Point Barrow; also discovers Vanavana, Fangataufa, and Ahunui in the Tuamotu archipelago.

1826 – Scottish explorer Alexander Gordon Laing becomes the first European to reach the fabled city of Timbuktu, but is murdered upon leaving the city.

1827 – Jedediah Smith crosses the Sierra Nevada (via Ebbets Pass) and the Great Basin.

1828 – French explorer René Caillié is the first European to return alive from Timbuktu.

1829–30 – John Ross discovers "Boothia Felix" (the Boothia Peninsula); the following year his nephew James Clark Ross crosses its narrow isthmus and reaches King William Island.

1830 – English explorer Richard Lander and his brother John descend the Niger for more than 643 kilometres (400 mi) from Bussa to its mouth.
1831–32 – John Biscoe discovers Enderby Land; following year discovers Adelaide, Anvers, and Biscoe Islands.

1833 – Andrei Glazunov and Semyon Lukin discover the mouth of the Yukon River.

1833–35 – Pyotr Pakhtusov and Avgust Tsivolko chart the entire east coast of Yuzhny Island, as well as the east coast of Severny Island north to nearly 74°24' N.

1834 – George Back descends the Back River to Chantrey Inlet.

1837 – Glazunov ascends the Unalakleet and portages to the middle Yukon.

1837–39 – Peter Warren Dease and Thomas Simpson reach Point Barrow from the east; following two summers they map the region from Point Turnagain to just north of the Castor and Pollux River on the Boothia Peninsula and chart the coastline of "Victoria Land" (Victoria Island) from Point Back to Point Parry.

1838 – Pyotr Malakhov reaches Nulato, near the confluence of the Koyukuk and Yukon.

1838–40 – Jules Dumont d'Urville discovers the Joinville Island group and Adélie Land (138°21' E).

1839 – John Balleny discovers the Balleny Islands and sights the Sabrina Coast (121° E).

1840 – An expedition led by United States Navy Lieutenant Charles Wilkes discovers Wilkes Land, mapping 2,414 kilometres (1,500 mi) of the Antarctic coast from Piner Bay (140°E) to the Shackleton Ice Shelf (97°E), proving that Antarctica is a continent.

1841–43 – James Clark Ross discovers the Ross Sea, reaches 78°09'30"S, and discovers the active volcano Mount Erebus on Ross Island, the Ross Ice Shelf, and Victoria Land. He also sights Snow Hill, Seymour, and James Ross Island.

1845 – John Bell discovers the Porcupine River, which he descends to its confluence with the Yukon.

1846 – Candido José da Costa Cardoso discovers Lake Malawi.

1846 – Rodrigues Graça travels from Angola to southwestern Katanga.

1846–47 – Scottish explorer John Rae maps over 1,046 kilometres (650 mi) of coastline from Lord Mayor Bay to Cape Crozier, discovering Committee Bay.

c. 1847–48 – António da Silva Porto reaches the upper Zambezi.

1848 – German missionary Johannes Rebmann is the first European to sight Mount Kilimanjaro.

1849 – David Livingstone and William Cotton Oswell cross the Kalahari Desert to Lake Ngami.

1849 – James Clark Ross charts 240 kilometres (150 mi) of the west coast of Somerset Island south to Cape Coulman, discovering Peel Sound.

1850 – Edwin De Haven sails up Wellington Channel, discovering and naming "Grinnell Land" (the Grinnell Peninsula, which forms the northwestern corner of Devon Island).
• 1850–54 – Robert McClure transits the Northwest Passage (by boat and sledge); he and his men also chart some 2,736 kilometres (1,700 mi) of new coastline, consisting of the entire coast of Banks Island and much of the northwestern coast of Victoria Island (from just east of Point Reynolds in the north to Prince Albert Sound in the south), in the process discovering Prince of Wales Strait and McClure Strait.
• 1851 – Rae charts over 965 kilometres (600 mi) of the southern coastline of Victoria Island, from Cape Back to Pelly Point.
• 1851 – Erasmus Ommanney, Sherard Osborn and William Browne chart the northern half of Prince of Wales Island, Osborn west to Sherard Osborn Point (72°20’ N) and Browne east to Pandora Island; meanwhile, Robert D. Aldrich charts the west coast of the Bathurst Island group north to Cape Aldrich (about 76°11’ N, on Île Vanier) and Dr. Abraham Bradford charts the east coast of Melville Island north to Bradford Point.
• 1851 – Robert Campbell descends the Pelly to the Yukon, which he descends to its confluence with the Porcupine, reaching Fort Yukon.
• 1851–52 – William Kennedy and Joseph René Bellot discover Bellot Strait and cross Prince of Wales Island east to west, reaching Ommanney Bay.
• 1852 – Edward Augustus Inglefield reaches 78° 28’ N, entering Smith Sound; also charts Jones Sound as far west as 84° 10' W.
• 1852–53 – Edward Belcher sails two of his squadron to the northwestern coast of the Grinnell Peninsula, wintering at 77° 52' N, 97° W; later circumnavigates the peninsula via Arthur Strait (now Fiord), discovering Cornwall and North Kent.
• 1853 – Richard Vesey Hamilton and George Henry Richards chart the Sabine Peninsula of Melville Island from Cape Mudge east to Bradford Point; the latter, along with Sherard Osborn, also charts the northern coast of Bathurst Island.
• 1853 – George Mecham discovers Prince Patrick and Eglinton Islands and charts the southwest corner of Melville Island; along with Francis Leopold McClintock, he charts nearly the entire coast of Prince Patrick; McClintock also charts the northwest coast of Melville Island, from Cape Fisher northwest to Cape Scott and south along its west coast to Cape Purchase.
• 1853–54 – American explorer Elisha Kent Kane and his men chart the Kane Basin and discover Kennedy Channel. One of his men, William Morton, reaches as far north as Kap Constitution (81°22’N).
• 1853–56 – Livingstone becomes the first to traverse Africa from west to east, traveling from Luanda in Angola to Quelimane in Mozambique; also explores much of the upper Zambezi and discovers and names Victoria Falls.
• 1854 – Rae charts the Boothia Peninsula from the Castor and Pollux River north to Point de la Guiche, discovering Rae Strait and proving the insularity of King William Island.
• 1858 – Richard Francis Burton and John Hanning Speke discover Lake Tanganyika and Lake Victoria.
- 1859 – McClintock charts the remaining 193 kilometres (120 mi) of the continental coastline of America (on the west coast of the Boothia Peninsula), while his companion Allen Young charts the southern half of Prince of Wales Island.

- 1860–61 – Robert O'Hara Burke and William Wills are the first to cross Australia from south to north, traveling from Melbourne to the Flinders River.

- 1862 – Speke discovers the Nile flowing from the northern end of Lake Victoria.

- 1862 – Ivan Lukin ascends the Yukon to Fort Yukon.

- 1864 – Samuel Baker discovers "Luta Nzige" (Lake Albert); in the distance he sights the Mountains of the Moon (the Rwenzori).

- 1865 – Edward Whymper is the first to ascend the Matterhorn.

- 1866–68 – A group of French colonial officers, led by Ernest Doudard de Lagrèe, undertakes a naval exploration and scientific expedition of the Mekong River and into Southern China.

- 1869 – American naturalist John Wesley Powell leads the first expedition to travel the entire length of the Colorado River through the Grand Canyon.

- 1869–70 – Carl Koldewey and Julius von Payer explore the east coast of Greenland from 74°18’ to 77°01’ N.

- 1871 – Charles Francis Hall reaches Robeson Channel, sailing his ship as far north as 82°11’ N; he later travels by sledge to 83°05’ N.

- 1872 – William Adams proves the insularity of Bylot Island.


- 1875–76 – George Nares sails as far north as 82°24’ N; the following year, Albert Hastings Markham sledges to 83°20’26” N, while Pelham Aldrich sledges along the northern coast of Ellesmere Island east to Alert Point and Lewis A. Beaumont explores the northwestern coast of Greenland.

- 1875–77 – Henry Morton Stanley circumnavigates both Lakes Tanganyika and Victoria, sights Lake George, and descends the Lualaba and Congo to the sea.

- 1876 – Luigi D'Albertis ascends over 800 kilometres (500 mi) up the Fly River in New Guinea.

- 1878–79 – Adolf Erik Nordenskiöld is the first to transit the Northeast Passage.

- 1881–83 – Adolphus Greely explores the interior of Ellesmere Island, discovering Lake Hazen; one of his men, James Booth Lockwood, crosses the island and reaches Greely Fiord, as well as sledging eastwards to the vicinity of Kap Washington (reaching 83° 23’08" N in the process).

- 1883–84 – German-American anthropologist Franz Boas is the first to see Nettilling Lake on Baffin Island.

- 1887–89 – Stanley traverses the Ituri Rainforest, explores the Rwenzori, and follows the Semliki to its source (which he names Lake Edward).
1892 – Robert Peary discovers and names Independence Bay and Peary Land.

1893–96 – Fridtjof Nansen and Hjalmar Johansen sledge to 86°13'06" N; their ship, the Fram, under Otto Sverdrup, drifts in the ice from the New Siberian Islands west to the northwest coast of Spitsbergen, reaching 85°55'05" N—a new record for a ship.

1898–1902 – Sverdrup and Gunnar Isachsen chart the western coast of Ellesmere Island and discover and name Axel Heiberg, Ellef Ringnes, Amund Ringnes, and King Christian Islands.

20th century

1900 – Peary explores the north coast of Greenland from Kap Washington to Kap Clarence Wyckoff, on the way reaching Cape Morris Jesup, the most northern point of mainland Greenland.

1902–04 – Robert Falcon Scott traces the length of the Ross Ice Shelf, discovers the Edward VII Peninsula, reaches about 82°11’ S (in the process tracing 600 kilometres (370 mi) of the west coast of the shelf), crosses the Transantarctic Mountains and discovers the Antarctic Plateau, penetrating nearly 240 kilometres (150 mi) into it; he is also the first to see the dry valleys of the Antarctic.

1903–06 – Norwegian polar explorer Roald Amundsen leads the first expedition to traverse the entire Northwest Passage, in the sloop Gjøa; Godfred Hansen, his second-in-command, charts the east coast of Victoria Island north to Cape Nansen (72°02’N, 104°45’W).

1906–07 – Ludvig Mylius-Erichsen and Johan Peter Koch chart the northeast coast of Greenland from Kap Bismarck (76°42’ N) to Kap Clarence Wyckoff (82°52’ N), discovering Danmark Fjord.

1908–09 – Frederick Cook and Peary each claim to have reached the North Pole—the former is a fraud, the latter widely doubted.

1910–11 – Bernhard Hantzsch crosses Baffin Island from Cumberland Sound to the Koukdjuak River, exploring the west coast of the island north to 68°45’N.

1911–12 – Amundsen becomes the first person to reach the South Pole. Scott and his team reach the Pole over a month later, all perishing on the return journey.

1913 – Frederick Bailey and Henry Morshead on their exploration of the Tsangpo Gorge discover the route of the Yarlung Tsangpo river.

1913–14 – Boris Vilkitsky and Per Novopashennyy discover Severnaya Zemlya, surveying parts of its eastern coast from Mys Arkticheskiy to Mys Vaygacha (its southeast point), as well as much of its south coast west to Mys Neupokoyeva.

1915–17 – Vilhjalmur Stefansson discovers Brock, Mackenzie King, Borden, Meighen, and Lougheed Islands; one of his men, Storker T. Storkerson, charts part of the northeast coast of Victoria Island, discovering the Storkerson Peninsula and Stefansson Island.
• 1924–29 – Joseph Dewey Soper explores the interior of Baffin Island before surveying its west coast north to Hantzsch River.

• 1926 – Amundsen, Lincoln Ellsworth and Umberto Nobile in the airship Norge are the first definitely known to have sighted the North Pole.

• 1927 – George P. Putnam charts the north coast of the Foxe Peninsula from Cape Dorchester to Bowman Bay.

• 1930–32 – Georgy Ushakov and Nikolay Urvantsev survey the entire coast of Severnaya Zemlya, showing it to be made up of four main islands: October Revolution, Komsomolets, Pioneer, and Bolshevik Islands—in all surveying some 2,200 kilometres (1,400 mi) of coastline and interior.

• 1932 – W. A. Poole discovers Prince Charles Island.

• 1934 – Richard E. Byrd discovers and names Roosevelt Island.

• 1937–41 – Thomas and Ella Manning map the west coast of Baffin Island from the Hantzsch River to Steensby Inlet.

• 1940 – Byrd discovers Thurston Island, believing it to be a peninsula.


• 1950 – Maurice Herzog and Louis Lachenal of the French Annapurna expedition become the first climbers to reach the summit of an 8,000-metre peak.

• 1953 – Edmund Hillary and Tenzing Norgay are the first to ascend Mount Everest.

• 1954 – Lino Lacedelli and Achille Compagnoni are the first to ascend K2 on the Italian Karakoram expedition.

• 1957 – Finn Ronne discovers Berkner Island.

### Timeline of European imperialism

#### Pre-1700

• 1402 Castilian invasion of Canary Islands.

• 1420-1425 Portuguese settlement of Madeira.

• 1433-1436 Portuguese settlement of Azores.

• 1445 Portuguese construction of trading post on Arguin island.

• 1450 Portuguese construction of trading post on Goree island.

• 1462 Portuguese settlement of Cape Verde islands.
• 1474 Portuguese settlement of Annobon island.
• 1470's Portuguese settlement of Bioko island.
• 1482 Portuguese construction of Elmina Castle.
• 1493 Portuguese settlement of Sao Tome and Principe.
• 1510 Portuguese conquest of Goa.
• 1511 Portuguese conquest of Malacca City.
• 1517 Portuguese conquest of Colombo.
• 1556 Portuguese colonisation of Timor.
• 1557 Portuguese construction of trading post in Macau.
• 1556-1599 Spanish conquest of Philippines.
• 1598: Dutch established colony on uninhabited island of Mauritius; they abandon it in 1710.
• 1608: Dutch opened their first trading post in India at Golconda.
• 1613: Dutch East India Company expands operations in Java.
• 1613–20: Netherlands becomes England's major rival in trade, fishing, and whaling. The Dutch form alliances with Sweden and the Hanseatic League; England counters with an alliance with Denmark.
• 1623. The Amboyna massacre occurs in Japan with execution of English traders; England closes its commercial base opened in 1613 at Hirado. Trade ends for more than two centuries.
• 1664. French East India Company Chartered for trade in Asia and Africa.

Colonization of North America

• 1565 – Saint Augustine, Florida – Spanish
• 1604 – Acadia – French
• 1605 – Port Royal – French; in Nova Scotia
• 1607 – Jamestown, Virginia – English; established by Virginia Company
• 1607 – Popham Colony – English; failed effort in Maine
• 1608 – Quebec, Canada – French
• 1610 – Cuper's Cove, First English settlement in Newfoundland; abandoned by 1820
• 1610 – Santa Fe, New Mexico – Spanish
• 1612 – Bermuda – English; established by Virginia Company
• 1615 – Fort Nassau – Dutch; became Albany New York
• 1620 – St. John's, Newfoundland – English; capital of Newfoundland
• 1620 – Plymouth Colony, absorbed by Massachusetts Bay – English; small settlement by Pilgrims
• 1621 – Nova Scotia – Scottish
• 1623 – Portsmouth, New Hampshire – English; becomes the Colony of New Hampshire
• 1625 – New Amsterdam – Dutch; becomes New York City
• 1630 – Massachusetts Bay Colony – English; The main Puritan colony.
• 1632 – Williamsburgh – English; becomes the capital of Virginia.
• 1633 – Fort Hoop – Dutch settlement; No part of Hartford Connecticut
• 1633 – Windsor, Connecticut – English
• 1634 – Maryland Colony – English
• 1635 – Territory of Sagadahock – English
• 1636 – Providence Plantations – English; became Rhode Island
• 1636 – Connecticut Colony – English
• 1638 – New Haven Colony – English; later merged into Connecticut colony
• 1638 – Fort Christina – Swedish; now part of Wilmington Delaware
• 1638 – Hampton, New Hampshire – English
• 1639 – San Marcos – Spanish
• 1640? – Swedesboro – Swedish
• 1651 – Fort Casimir – Dutch
• 1660 – Bergen – Dutch
• 1670 – Charleston, South Carolina – English
• 1682 – Pennsylvannia – English Quakers;
• 1683? – Fort Saint Louis (Illinois) – French;
• 1683 – East New Jersey – Scottish
• 1684 – Stuarts Town, Carolina – Scottish
• 1685 – Fort Saint Louis (Texas) – French
• 1698 – Pensacola, Florida – Spanish
• 1699 – Louisiana (New France) – French;
1700 to 1799

- 1704: Gibraltar captured by British on 4 August; becomes British naval bastion into the 21st century
- 1756–63 Seven Years' War, Britain, Prussia, and Hanover against France, Austria, the Russian Empire, Sweden, and Saxony. Major battles in Europe and North America; the East India Company also in involved in the Third Carnatic War (1756–1763) in India. Britain victorious and takes control of all of Canada; France seeks revenge.
- 1775–83: American Revolutionary War as 13 Colonies revolt; Britain has no major allies. It is the first successful colonial revolt in European history.
  - 1783: Treaty of Paris ends Revolutionary War; British give generous terms to US with boundaries as British North America on north, Mississippi River on west, Florida on south. Britain gives East and West Florida to Spain
- 1784: Britain allows trade with America but forbid some American food exports to West Indies; British exports to America reach £3.7 million, imports only £750,000
- 1784: Pitt's India Act re-organised the British East India Company to minimise corruption; it centralised British rule by increasing the power of the Governor-General

1793 to 1870

- 1792: In India, British victory over Tipu Sultan in Third Anglo-Mysore War; cession of one half of Mysore to the British and their allies.
- 1793–1815: Wars of the French Revolution, and Napoleonic wars; French conquests spread Ideas of the French Revolution, including abolition of serfdom, modern legal systems, and of Holy Roman Empire; stimulate rise of nationalism
- 1804–1865: Russia expand across Siberia to Pacific.
- 1804–1813: Uprising in Serbia against the ruling Ottoman Empire
- 1807: Britain makes the international slave trade criminal; Slave Trade Act 1807; United States criminalizes the international slave trade at the same time.
- 1810–1820s: Spanish American wars of independence
- 1810–1821: Mexican War of Independence
- 1814–15: Congress of Vienna; Reverses French conquests; restores reactionaries to power. However, many liberal reforms persist; Russia emerges as a powerful factor in European affairs.
• 1815–1817: Serbian uprising leading to Serbian autonomy
• 1819: Stamford Raffles founds Singapore as outpost of British Empire.
• 1821–1823: Greek War of Independence
• 1822: Independence of Brazil proclaimed by Dom Pedro I
• 1822–27: George Canning in charge of British foreign policy, avoids co-operation with European powers.
• 1823: United States issues Monroe Doctrine to preserve newly independent Latin American states; issued in cooperation with Britain, whose goal is to prevent French & Spanish influence and allow British merchants access to the opening markets. American goal is to prevent the New World becoming a battlefield among European powers.
• 1821–32: Greece wins Greek War of Independence against the Ottoman Empire; the 1832 Treaty of Constantinople is ratified at the London Conference of 1832.
• 1830: Start of the French conquest of Algeria
• 1833: Slavery Abolition Act 1833 frees slaves in British Empire; the owners (who mostly reside in Britain) are paid £20 million.
• 1839–42: Britain wages First Opium War against China
• 1842: Britain forces China to sign the Treaty of Nanking. It opens trade, cedes territory (especially Hong Kong), fixes Chinese tariffs at a low rate, grants extraterritorial rights to foreigners, and provides both a most favoured nation clause, as well as diplomatic representation.
• 1845: Oregon boundary dispute threatens war between Great Britain and the United States.
• 1846: The Corn Laws are repealed; free trade in grain strengthens the British economy By increasing trade with exporting nations.
• 1845: Republic of Texas voluntarily joins the United States. Annexation causes the Mexican–American War, 1846–48.
• 1848: United States victorious in Mexican–American War; annexes area from New Mexico to California
• 1848–49: Second Sikh war; the British East India Company subjugates the Sikh Empire, and annexes Punjab
• 1857: Indian Mutiny suppressed. It has major long-term impact on reluctance to grant independence to Indians.
- 1858: The government of India transferred from East India Company to the crown; the government appoints a viceroy. He rules portions of India directly, and dominates local princes in the other portions. British rule guarantees that local wars will not happen inside India.
- 1861–1867: French intervention in Mexico; United States demands French withdrawal after 1865; France removes its army, and its puppet Emperor is executed.
- 1862: Treaty of Saigon; France occupies three provinces in southern Vietnam.
- 1863: France establishes a protectorate over Cambodia.
- 1867: British North America Act, 1867 creates the Dominion of Canada, a federation with internal self-government; foreign and defence matters are still handled by London.

1870–1914

- 1874: Second Treaty of Saigon, France controls all of South Vietnam
- 1875–1900: Britain, France, Germany, Portugal and Italy join in the Scramble for Africa
- 1876: Korea signs unequal treaty with Japan
- 1878: Austria occupies Bosnia-Herzegovina while Ottoman Empire is at war with Russia
- 1878: Ottoman Empire loses main possessions in Europe; Treaty of Berlin recognising the independence of Romania, Serbia and Montenegro and the autonomy of Bulgaria
- 1882: Korea signs unequal treaties with the United States and others
- 1884: France makes Vietnam a colony.
- 1885: King Leopold of Belgium establishes the Congo Free State, under his personal control. There is no role for the government of Belgium until the King's financial difficulties lead to a series of loans; it takes over in 1908.
- 1893: France makes Laos a protectorate.
- 1893: Overthrow of the Kingdom of Hawaii
- 1895: Creation of French West Africa (AOF)
- 1895–1910: Japan takes full control of Korea.
- 1898: Fashoda Incident in Africa threatens war between France and Britain; Settled peacefully
- 1898: United States demands that Spain immediately reform its rule in Cuba; Spain procrastinates; US wins short Spanish–American War
- 1898: Annexation of the Republic of Hawaii as a United States territory via the Newlands Resolution
- 1898: In Treaty of Paris, US obtains the Philippines, Guam, Puerto Rico, and makes Cuba a protectorate. For the first time US has an overseas empire.
1899–1900: Anti-imperialist sentiment in the United States mobilizes but fails to stop the expansion.

1900-08: King Leopold is denounced worldwide for his maltreatment of rubber workers in Congo. The campaign is led by journalist E.D. Morel.

1908: Austria annexes Bosnia and Herzegovina; pays compensation for it; Serbia is outraged.

1914: Most Frenchmen ignored foreign affairs and colonial issues. The chief pressure group was the Parti colonial, a coalition of 50 organizations with a combined total of 5,000 members.

**Timeline of human prehistory**

- 315,000 years ago: approximate date of appearance of Homo sapiens (Jebel Irhoud, Morocco).
- 270,000 years ago: age of Y-DNA haplogroup A00 ("Y-chromosomal Adam").
- 250,000 years ago: first appearance of Homo neanderthalensis (Saccopastore skulls).
- 250,000–200,000 years ago: modern human presence in West Asia (Misliya cave).
- 230,000–150,000 years ago: age of mt-DNA haplogroup L ("Mitochondrial Eve").
- 210,000 years ago: modern human presence in southeast Europe (Apidima, Greece).
- 195,000 years ago: Omo remains (Ethiopia).
- 170,000 years ago: humans are wearing clothing by this date.
- 160,000 years ago: Homo sapiens idaltu.
- 150,000 years ago: Peopling of Africa: Khoisanid separation, age of mtDNA haplogroup L0.
- 125,000 years ago: peak of the Eemian interglacial period.
- 120,000 years ago: SE Australian Aboriginal people were cooking on hearths. Charcoal and Burnt Stone Feature #1 (CBS1) located within coastal dune sediments at Moyjil (Point Ritchie), Warrnambool, that independent geomorphic and OSL dating indicates is of Last Interglacial age (~120,000 years ago).
- 120,000–90,000 years ago: Abbassia Pluvial in North Africa—the Sahara desert region is wet and fertile.
- 120,000–75,000 years ago: Khoisanid back-migration from Southern Africa to East Africa.
- 100,000 years ago: Earliest structures in the world (sandstone blocks set in a semi-circle with an oval foundation) built in Egypt close to Wadi Halfa near the modern border with Sudan.
- 82,000 years ago: small perforated seashell beads from Taforalt in Morocco are the earliest evidence of personal adornment found anywhere in the world.
- 80,000–70,000 years ago: Recent African origin: separation of sub-Saharan Africans and non-Africans.
- 75,000 years ago: Toba Volcano supereruption that may have contributed to human populations being lowered to about 15,000 people.
• 70,000 years ago: earliest example of abstract art or symbolic art from Blombos Cave, South Africa—stones engraved with grid or cross-hatch patterns.

• 67,000–40,000 years ago: Neanderthal admixture to Eurasians.

• 50,000 years ago: earliest sewing needle found. Made and used by Denisovans.

• 50,000–30,000 years ago: Mousterian Pluvial in North Africa. The Sahara desert region is wet and fertile. Later Stone Age begins in Africa.

• 45,000–43,000 years ago: European early modern humans.

• 45,000–40,000 years ago: Châtelperronian cultures in France.

• 42,000 years ago: Paleolithic flutes in Germany.

• 42,000 years ago: earliest evidence of advanced deep sea fishing technology at the Jerimalai cave site in East Timor—demonstrates high-level maritime skills and by implication the technology needed to make ocean crossings to reach Australia and other islands, as they were catching and consuming large numbers of big deep sea fish such as tuna.

• 41,000 years ago: Denisova hominin lives in the Altai Mountains.

• 40,000 years ago: extinction of Homo neanderthalensis.

• 40,000 years ago: Aurignacian culture begins in Europe.

• 40,000 years ago: oldest known figurative art the zoomorphic Löwenmensch figurine.

• 40,000–30,000 years ago: First human settlements formed by Aboriginal Australians in several areas which are today the cities of Sydney, Perth and Melbourne.

• 40,000–20,000 years ago: oldest known ritual cremation, the Mungo Lady, in Lake Mungo, Australia.

• 35,000 years ago: oldest known figurative art of a human figure as opposed to a zoomorphic figure (Venus of Hohle Fels).

• 33,000 years ago: oldest known domesticated dog skulls show they existed in both Europe and Siberia by this time.

• 31,000–16,000 years ago: Last Glacial Maximum (peak at 26,500 years ago).

• 30,000 years ago: rock paintings tradition begins in Bhimbetka rock shelters in India, which presently as a collection is the densest known concentration of rock art. In an area about 10 km square, there are about 800 rock shelters of which 500 contain paintings.

• 29,000 years ago: The earliest ovens found.

• 28,500 years ago: New Guinea is populated by colonists from Asia or Australia.

• 28,000 years ago: oldest known twisted rope.

• 28,000–24,000 years ago: oldest known pottery—used to make figurines rather than cooking or storage vessels (Venus of Dolní Věstonice).
• 28,000–20,000 years ago: Gravettian period in Europe. Harpoons and saws invented.
• 26,000 years ago: people around the world use fibers to make baby carriers, clothes, bags, baskets, and nets.
• 25,000 years ago: a hamlet consisting of huts built of rocks and of mammoth bones is founded in what is now Dolní Věstonice in Moravia in the Czech Republic. This is the oldest human permanent settlement that has yet been found by archaeologists.
• 21,000 years ago: artifacts suggest early human activity occurred in Canberra, the capital city of Australia.
• 20,000 years ago: Kebaran culture in the Levant: beginning of the Epipalaeolithic in the Levant
• 20,000 years ago: oldest pottery storage or cooking vessels from China.
• 20,000–10,000 years ago: Khoisanid expansion to Central Africa.
• 20,000–19,000 years ago: earliest pottery use, in Xianren Cave, China.
• 18,000–12,000 years ago: Though estimations vary widely, it is believed by scholars that Afro-Asiatic was spoken as a single language around this time period.
• 16,000–14,000 years ago: Minatogawa Man (Proto-Mongoloid phenotype) in Okinawa, Japan
• 16,000–13,000 years ago: first human migration into North America.
• 16,000–11,000 years ago: Caucasian Hunter-Gatherer expansion to Europe.
• 16,000 years ago: Wisent (European bison) sculpted in clay deep inside the cave now known as Le Tuc d'Audoubert in the French Pyrenees near what is now the border of Spain.
• 15,000–14,700 years ago (13,000 BC to 12,700 BC): Earliest supposed date for the domestication of the pig.
• 14,800 years ago: The Humid Period begins in North Africa. The region that would later become the Sahara is wet and fertile, and the aquifers are full.
• 14,500–11,500: Red Deer Cave people in China, possible late survival of archaic or archaic-modern hybrid humans.
• 14,000–12,000 years ago: Oldest evidence for prehistoric warfare (Jebel Sahaba massacre, Natufian culture).
• 13,000–10,000 years ago: Late Glacial Maximum, end of the Last glacial period, climate warms, glaciers recede.
• 13,000 years ago: A major water outbreak occurs on Lake Agassiz, which at the time could have been the size of the current Black Sea and the largest lake on Earth. Much of the lake is drained in the Arctic Ocean through the Mackenzie River.
• 13,000–11,000 years ago: Earliest dates suggested for the domestication of the sheep.
• 12,900–11,700 years ago: the Younger Dryas was a period of sudden cooling and return to glacial conditions.

• 12,000 years ago: Jericho has evidence of settlement dating back to 10,000 BC. Jericho was a popular camping ground for Natufian hunter-gatherer groups, who left a scattering of crescent microlith tools behind them.

• 12,000 years ago: Earliest dates suggested for the domestication of the goat.

• 11,600 years ago (9,600 BC): An abrupt period of global warming accelerates the glacial retreat; taken as the beginning of the Holocene geological epoch.

• 11,200–11,000 years ago: Meltwater pulse 1B, a sudden rise of sea level by 7.5 m within about 160 years.

• 11,000 years ago (9,000 BC): Earliest date recorded for construction of temenoi ceremonial structures at Göbekli Tepe in southern Turkey, as possibly the oldest surviving proto-religious site on Earth.

• 11,000 years ago (9,000 BC): Emergence of Jericho, which is now one of the oldest continuously inhabited cities in the world. Giant short-faced bears and giant ground sloths go extinct. Equidae goes extinct in North America.

• 10,500 years ago (8,500 BC): Earliest supposed date for the domestication of cattle.

• 10,000 years ago (8,000 BC): The Quaternary extinction event, which has been ongoing since the mid-Pleistocene, concludes. Many of the ice age megafauna go extinct, including the megatherium, woolly rhinoceros, Irish elk, cave bear, cave lion, and the last of the sabre-toothed cats. The mammoth goes extinct in Eurasia and North America, but is preserved in small island populations until ~1650 BC.

• 10,800–9,000 years ago: Byblos appears to have been settled during the PPNB period, approximately 8800 to 7000 BC. Neolithic remains of some buildings can be observed at the site.

• 10,000–8,000 years ago (8000 BC to 6000 BC): The post-glacial sea level rise decelerates, slowing the submersion of landmasses that had taken place over the previous 10,000 years.

• 10,000–9,000 years ago (8000 BC to 7000 BC): In northern Mesopotamia, now northern Iraq, cultivation of barley and wheat begins. At first they are used for beer, gruel, and soup, eventually for bread. In early agriculture at this time, the planting stick is used, but it is replaced by a primitive plow in subsequent centuries. Around this time, a round stone tower, now preserved to about 8.5 meters high and 8.5 meters in diameter is built in Jericho.

• 10,000–5,000 years ago (8,000–3,000 BC) Identical ancestors point: sometime in this period lived the latest subgroup of human population consisting of those that were all common ancestors of all present day humans, the rest having no present day descendants.

• 9,500–5,500 years ago: Neolithic Subpluvial in North Africa. The Sahara desert region supports a savanna-like environment. Lake Chad is larger than the current Caspian Sea. An African culture develops across the current Sahel region.
• 9,500 years ago (7500 BC): Çatalhöyük urban settlement founded in Anatolia. Earliest supposed date for the domestication of the cat.

• 9,200 years ago: First human settlement in Amman, Jordan; 'Ain Ghazal Neolithic settlement was built spanning over an area of 15 hectares.

• 9,000 years ago (7000 BC): Jiahu culture began in China.

• 9,000 years ago: large first fish fermentation in southern Sweden.

• 8,200–8,000 years ago: 8.2 kiloyear event: a sudden decrease of global temperatures, probably caused by the final collapse of the Laurentide Ice Sheet, which leads to drier conditions in East Africa and Mesopotamia.

• 8,200–7,600 years ago (6200 ± 5600 BC): sudden rise in sea level (Meltwater pulse 1C) by 6.5 m in less than 140 year; this concludes the early Holocene sea level rise and sea level remains largely stable throughout the Neolithic.

• 8,000–5,000 years ago: (6000 BC–3000 BC) development of proto-writing in China, Southeast Europe (Vinca symbols) and West Asia (proto-literate cuneiform).

• 8,000 years ago: Evidence of habitation at the current site of Aleppo dates to about c. 8,000 years ago, although excavations at Tell Qaramel, 25 kilometers north of the city show the area was inhabited about 13,000 years ago, Carbon-14 dating at Tell Ramad, on the outskirts of Damascus, suggests that the site may have been occupied since the second half of the seventh millennium BC, possibly around 6300 BC. However, evidence of settlement in the wider Barada basin dating back to 9000 BC exists.

• 7,500 years ago (5500 BC): Copper smelting in evidence in Pločnik and other locations.

• 7,200–6,000 years ago: 5200–4000 BC:Ghar Dalam phase on Malta. First farming settlements on the island.

• 6,100–5,800 years ago: 4100–3800 BC: Žebbug phase. Malta.

• 6,070–6,000 years ago (4050–4000 BC): Trypillian build in Nebelivka (Ukraine) settlement which reached 15,000–18,000 inhabitants.

• 6,500 years ago: The oldest known gold hoard deposited at Varna Necropolis, Bulgaria.

• 6,000 years ago (4000 BC): Civilizations develop in the Mesopotamia/Fertile Crescent region (around the location of modern-day Iraq). Earliest supposed dates for the domestication of the horse and for the domestication of the chicken, invention of the potter's wheel.

• 5,800 years ago: (3840 to 3800 BC): The Post Track and Sweet Track causeways are constructed in the Somerset Levels.
5,800 years ago (3800 BC): Trypillian build in Talianki (Ukraine) settlement which reached 15,600–21,000 inhabitants.

5,800–5,600 years ago (3800–3600 BC): Mgarr phase A short transitional period in Malta's prehistory. It is characterized by pottery consisting of mainly curved lines.

5,700 years ago (3800 to 3600 BC): mass graves at Tell Brak in Syria.

5,700 years ago (3700 BC): Trypillian build in Maidanets (Ukraine) settlement which reached 12,000–46,000 inhabitants, and built 3-storey building.

5,700 years ago: (3700 to 3600 BC): Minoan culture begins on Crete.

5,600–5,200 years ago (3600–3200 BC): Ġgantija phase on Malta. Characterized by a change in the way the prehistoric inhabitants of Malta lived.

5,500 years ago: (3600 to 3500 BC): Uruk period in Sumer. First evidence of mummification in Egypt.

5,500: oldest known depiction of a wheeled vehicle (Bronocice pot, Funnelbeaker culture)

5,500 years ago: Earliest conjectured date for the still-undeciphered Indus script.

5,500 years ago: End of the African humid period possibly linked to the Piora Oscillation: a rapid and intense aridification event, which probably started the current Sahara Desert dry phase and a population increase in the Nile Valley due to migrations from nearby regions. It is also believed this event contributed to the end of the Ubaid period in Mesopotamia.

5,300 years ago: (3300 BC): Bronze Age begins in the Near East Newgrange is built in Ireland. Ness of Brodgar is built in Orkney Hakra Phase of the Indus Valley Civilisation begins in the Indian subcontinent.

5,300–5,000 years ago (3300–3000 BC): Saflieni phase in Maltese prehistory.

5,000 years ago: Settlement of Skara Brae built in Orkney.

4,600 years ago: (2600 BC): Writing is developed in Sumer and Egypt, triggering the beginning of recorded history.

3,800 years ago (1800 BC): Currently undeciphered Minoan script (Linear A) and Cypro-Minoan script developed on Crete and Cyprus.

3,450 years ago (1450 BC): Mycenean Greece, first deciphered writing in Europe

3,200 years ago (1200 BC): Oracle bone script, first written records in Old Chinese

3,050–2,800 years ago: Alphabetic writing; the Phoenician alphabet spreads around the Mediterranean

2,300 years ago: Maya writing, the only known full writing system developed in the Americas, emerges.

2,260 years ago (260 BC): Earliest deciphered written records in South Asia (Middle Indo-Aryan)

1800s AD: Undeciphered Rongorongo script on Easter Island may mark the latest independent development of writing.
Timeline of natural history

- **ka** (for kiloannum) – a unit of time equal to one thousand, or \(10^3\) years, or 1 E3 yr, also known as a millennium in anthropology and calendar uses. The prefix multiplier "ka" is typically used in geology, paleontology, and archaeology for the Holocene and Pleistocene periods, where a non–radiocarbon dating technique: e.g. ice core dating, dendrochronology, uranium-thorium dating, or varve analysis; is used as the primary dating method for age determination. If age is determined primarily by radiocarbon dating, then the age should be expressed in either radiocarbon or calendar (calibrated) years Before Present.

- **Ma** (for megaannum) – a unit of time equal to one million, or \(10^6\) years, or 1 E6 yr. The suffix "Ma" is commonly used in scientific disciplines such as geology, paleontology, and celestial mechanics to signify very long time periods into the past or future. For example, the dinosaur species *Tyrannosaurus rex* was abundant approximately 66 Ma (66 million years) ago. The duration term "ago" may not always be indicated: if the quantity of a duration is specified while not explicitly mentioning a duration term, one can assume that "ago" is implied; the alternative unit "mya" does include "ago" explicitly. It is also written as "million years" (ago) in works for general public use. In astronomical applications, the year used is the Julian year of precisely 365.25 days. In geology and paleontology, the year is not so precise and varies depending on the author.

- **Ga** (for gigaannum) – a unit of time equal to \(10^9\) years, or one billion years. "Ga" is commonly used in scientific disciplines such as cosmology and geology to signify extremely long time periods in the past. For example, the formation of the Earth occurred approximately 4.54 Ga (4.54 billion years) ago and the age of the universe is approximately 13.8 Ga.

- **Ta** (for teraannum) – a unit of time equal to \(10^{12}\) years, or one trillion years. "Ta" is an extremely long unit of time, about 70 times as long as the age of the universe. It is the same order of magnitude as the expected life span of a small red dwarf.

- **Pa** (for petaannum) – a unit of time equal to \(10^{15}\) years, or one quadrillion years. The half-life of the nuclide cadmium-113 is about 8 Pa. This symbol coincides with that for the pascal without a multiplier prefix, though both are infrequently used and context will normally be sufficient to distinguish time from pressure values.

- **Ea** (for exaannum) – a unit of time equal to \(10^{18}\) years, or one quintillion years. The half-life of tungsten-180 is 1.8 Ea.

The earliest Solar System

In the earliest Solar System history, the Sun, the planetesimals and the jovian planets were formed. The inner Solar System aggregated more slowly than the outer, so the terrestrial planets were not yet formed, including Earth and Moon.
• c.4,570 Ma – A supernova explosion (known as the primal supernova) seeds our galactic neighborhood with heavy elements that will be incorporated into the Earth, and results in a shock wave in a dense region of the Milky Way galaxy. The Ca-Al-rich inclusions, which formed 2 million years before the chondrules, are a key signature of a supernova explosion.

• c.4,567±3 Ma – Rapid collapse of hydrogen molecular cloud, forming a third-generation Population I star, the Sun, in a region of the Galactic Habitable Zone (GHZ), about 25,000 light years from the center of the Milky Way Galaxy.

• c.4,566±2 Ma – A protoplanetary disc (from which Earth eventually forms) emerges around the young Sun, which is in its T Tauri stage.

• c.4,560–4,550 Ma – Proto-Earth forms at the outer (cooler) edge of the habitable zone of the Solar System. At this stage the solar constant of the Sun was only about 73% of its current value, but liquid water may have existed on the surface of the Proto-Earth, probably due to the greenhouse warming of high levels of methane and carbon dioxide present in the atmosphere. Early bombardment phase begins: because the solar neighbourhood is rife with large planetoids and debris, Earth experiences a number of giant impacts that help to increase its overall size.

Precambrian Supereon

• c.4,533 Ma – The Precambrian (to c.541 Ma), now termed a "supereon" but formerly an era, is split into three geological periods called eons: Hadean, Archaean and Proterozoic. The latter two are sub-divided into several eras as currently defined. In total, the Precambrian comprises some 85% of geological time from the formation of Earth to the time when creatures first developed exoskeletons (i.e., hard outer parts) and thereby left abundant fossil remains.

Hadean Eon

• c.4,533 Ma – Hadean Eon, Precambrian Supereon and unofficial Cryptic era start as the Earth-Moon system forms, possibly as a result of a glancing collision between proto-Earth and the hypothetical protoplanet Theia. (The Earth was considerably smaller than now, before this impact.) This impact vaporized a large amount of the crust, and sent material into orbit around Earth, which lingered as rings, similar to those of Saturn, for a few million years, until they coalesced to become the Moon. The Moon geology pre-Nectarian period starts. Earth was covered by a magmatic ocean 200 kilometres (120 mi) deep resulting from the impact energy from this and other planetesimals during the early bombardment phase, and energy released by the planetary core forming. Outgassing from crustal rocks gives Earth a reducing atmosphere of methane, nitrogen, hydrogen, ammonia, and water vapour, with lesser amounts of hydrogen sulfide, carbon monoxide, then carbon dioxide. With further full outgassing over
1000-1500 K, nitrogen and ammonia become lesser constituents, and comparable amounts of methane, carbon monoxide, carbon dioxide, water vapour, and hydrogen are released.

- c.4,450 Ma – 100 million years after the Moon formed, the first lunar crust, formed of lunar anorthosite, differentiates from lower magmas. The earliest Earth crust probably forms similarly out of similar material. On Earth the pluvial period starts, in which the Earth's crust cools enough to let oceans form.
- c.4,404 Ma – First known mineral, found at Jack Hills in Western Australia. Detrital zircons show presence of a solid crust and liquid water. Latest possible date for a secondary atmosphere to form, produced by the Earth’s crust outgassing, reinforced by water and possibly organic molecules delivered by comet impacts and carbonaceous chondrites (including type CI shown to be high in a number of amino acids and polycyclic aromatic hydrocarbons (PAH)).
- c.4,300 Ma – Nectarian Era begins on Earth.
- c.4,250 Ma – Earliest evidence for life, based on unusually high amounts of light isotopes of carbon, a common sign of life, found in Earth's oldest mineral deposits located in the Jack Hills of Western Australia.
- c.4,100 Ma – Early Imbrian Era begins on Earth. Late heavy bombardment of the Moon (and probably of the Earth as well) by bolides and asteroids, produced possibly by the planetary migration of Neptune into the Kuiper belt as a result of orbital resonances between Jupiter and Saturn. "Remains of biotic life" were found in 4.1 billion-year-old rocks in Western Australia. According to one of the researchers, "If life arose relatively quickly on Earth ... then it could be common in the universe."
- c.4,030 Ma – Acasta Gneiss of Northwest Territories, Canada, first known oldest rock, or aggregate of minerals.

**Archean Eon**

**Eoarchean Era**

- c.4,000 Ma – Archean Eon and Eoarchean Era start. Possible first appearance of plate tectonic activity in the Earth's crust as plate structures may have begun appearing. Possible beginning of Napier Mountains Orogeny forces of faulting and folding create first metamorphic rocks. Origins of life.
- c.3,930 Ma – Possible stabilization of Canadian Shield begins
- c.3,920–3,850 Ma – Final phase of Late Heavy Bombardment
- c.3,850 Ma – Greenland apatite shows evidence of $^{12}$C enrichment, characteristic of the presence of photosynthetic life.
• c.3,850 Ma – Evidence of life: Akilia Island graphite off Western Greenland contains evidence of kerogen, of a type consistent with photosynthesis.

• c.3,800 Ma – Oldest banded iron formations found. First complete continental masses or cratons, formed of granite blocks, appear on Earth. Occurrence of initial felsic igneous activity on eastern edge of Antarctic craton as first great continental mass begins to coalesce. East European Craton begins to form - first rocks of the Ukrainian Shield and Voronzh Massif are laid down

• c.3,750 Ma – Nuvvuagittuq Greenstone Belt forms

• c.3,700 Ma – Graphite found to be biogenic in 3.7 billion-year-old metasedimentary rocks discovered in Western Greenland Stabilization of Kaapval craton begins: old tonaltic gneisses laid down

Paleoarchean Era

• c.3,600 Ma – Paleoarchean Era starts. Possible assembly of the Vaalbara supercontinent; oldest cratons on Earth (such as the Canadian Shield, East European Craton and Kaapval) begin growing as a result of crustal disturbances along continents coalescing into Vaalbara - Pilbara Craton stabilizes. Formation of Barberton greenstone belt: Makhonjwa Mountains uplifts on the eastern edge of Kaapval craton, oldest mountains in Africa - area called the "genesis of life" for exceptional preservation of fossils. Narryer Gneiss Terrane stabilizes: these gneisses become the "bedrock" for the formation of the Yilgarn Craton in Australia - noted for the survival of the Jack Hills where the oldest mineral, a zircon was uncovered.

• c.3,500 Ma – Lifetime of the Last universal ancestor: split between bacteria and archaea occurs as "tree of life" begins branching out - varieties of Eubacteria begin to radiate out globally. Fossils resembling cyanobacteria, found at Warrawoona, Western Australia.

• c.3,480 Ma – Fossils of microbial mat found in 3.48 billion-year-old sandstone discovered in Western Australia. First appearance of stromatolitic organisms that grow at interfaces between different types of material, mostly on submerged or moist surfaces.

• c.3,460 Ma – Fossils of bacteria in chert. Zimbabwe Craton stabilizes from the suture of two smaller crustal blocks, the Tokwe Segment to the south and the Rhodesdale Segment or Rhodesdale gneiss to the north.

• c.3,400 Ma – Eleven taxa of prokaryotes are preserved in the Apex Chert of the Pilbara craton in Australia. Because chert is fine-grained silica-rich microcrystalline, cryptocrystalline or microfibrous material, it preserves small fossils quite well. Stabilization of Baltic Shield begins.

• c.3,340 Ma – Johannesburg Dome forms in South Africa: located in the central part of Kaapvaal Craton and consists of trondhjemitic and tonalitic granitic rocks intruded into mafic-ultramafic greenstone - the oldest granitoid phase recognised so far.

• c.3,300 Ma – Onset of compressional tectonics. Intrusion of granitic plutons on the Kaapvaal Craton.
• c.3,260 Ma – One of the largest recorded impact events occurs near the Barberton Greenstone Belt, when a 58 km (36 mi) asteroid leaves a crater almost 480 km (300 mi) across – two and a half times larger in diameter than the Chicxulub crater.

Mesoarchean Era

• c.3,200 Ma – Mesoarchean Era starts. Onverwacht series in South Africa form - contain some of the oldest microfossils mostly spheroidal and carbonaceous alga-like bodies.
• c.3,200–2,600 Ma – Assembly of the Ur supercontinent to cover between 12–16% of the current continental crust. Formation of Limpopo Belt.
• c.3,100 Ma – Fig Tree Formation: second round of fossilizations including Archaeosphaeroides barbertonensis and Eobacterium. Gneiss and greenstone belts in the Baltic Shield are laid down in Kola Peninsula, Karelia and northeastern Finland.
• c.3,000 Ma – Humboldt Orogeny in Antarctica: possible formation of Humboldt Mountains in Queen Maud Land. Photosynthesizing cyanobacteria evolve; they use water as a reducing agent, thereby producing oxygen as a waste product. The oxygen initially oxidizes dissolved iron in the oceans, creating iron ore - over time oxygen concentration in the atmosphere slowly rises, acting as a poison for many bacteria. As Moon is still very close to Earth and causes tides 1,000 feet (305 m) high, the Earth is continually wracked by hurricane-force winds - these extreme mixing influences are thought to stimulate evolutionary processes. Rise of Stromatolites: microbial mats become successful forming the first reef building communities on Earth in shallow warm tidal pool zones (to 1.5 Gyr). Tanzania Craton forms.
• c.2,940 Ma – Yilgarn Craton of western Australia forms by the accretion of a multitude of formerly present blocks or terranes of existing continental crust.
• c.2,900 Ma – Assembly of the Kenorland supercontinent, based upon the core of the Baltic shield, formed at c.3100 Ma. Narryer Gneiss Terrane (including Jack Hills) of Western Australia undergoes extensive metamorphism.

Neoarchean Era

• c.2,800 Ma – Neoarchean Era starts. Breakup of the Vaalbara: Breakup of supercontinent Ur as it becomes a part of the major supercontinent Kenorland. Kaapvaal and Zimbabwe cratons join together.
• c.2,770 Ma – Formation of Hamersley Basin on the southern margin of Pilbara Craton - last stable submarine-fluvial environment between the Yilgarn and Pilbara prior to rifting, contraction and assembly of the intracratonic Gascoyne Complex.
• c.2,750 Ma – Renosterkoppies Greenstone Belt forms on the northern edge of the Kaapvaal Craton.
• c.2,736 Ma – Formation of the Temagami Greenstone Belt in Temagami, Ontario, Canada.
• c.2,707 Ma – Blake River Megacaldera Complex begins to form in present-day Ontario and Quebec - first known Precambrian supervolcano - first phase results in creation of 8 km long, 40 km wide, east-west striking Misema Caldera - coalescence of at least two large mafic shield volcanoes.

• c.2,705 Ma – Major komatiite eruption, possibly global - possible mantle overturn event.

• c.2,704 Ma – Blake River Megacaldera Complex: second phase results in creation of 30 km long, 15 km wide northwest-southeast trending New Senator Caldera - thick massive mafic sequences which has been inferred to be a subaqueous lava lake.

• c.2,700 Ma – Biomarkers of cyanobacteria discovered, together with steranes (sterols of cholesterol), associated with films of eukaryotes, in shales located beneath banded iron formation hematite beds, in Hamersley Range, Western Australia; skewed sulfur isotope ratios found in pyrites show a small rise in oxygen concentration in the atmosphere; Sturgeon Lake Caldera forms in Wabigoon greenstone belt — contains well preserved homoclinal chain of greenschist facies, metamorphosed intrusive, volcanic and sedimentary layers (Mattabi pyroclastic flow considered third most voluminous eruptive event); stromatolites of Bulawayo series in Zimbabwe form — first verified reef community on Earth.

• c.2,696 Ma – Blake River Megacaldera Complex: third phase of activity constructs classic east-northeast striking Noranda Caldera which contains a 7-to-9-km-thick succession of mafic and felsic rocks erupted during five major series of activity. Abitibi greenstone belt in present-day Ontario and Quebec begins to form: considered world's largest series of Archean greenstone belts, appears to represent a series of thrusted subterranes.

• c.2,690 Ma – Formation of high pressure granulites in the Limpopo Central Region.

• c.2,650 Ma – Insell Orogeny: occurrence of a very high grade discrete tectonothermal event (a UHT metamorphic event).

• c.2,600 Ma – Oldest known giant carbonate platform. Saturation of oxygen in ocean sediments is reached as oxygen now begins to dramatically appear in Earth's atmosphere.

Proterozoic Eon

The Proterozoic (from c.2500 Ma to c.541 Ma) saw the first traces of biological activity. Fossil remains of bacteria and algae.

Paleoproterozoic Era

Siderian Period

• c.2,500 Ma – Proterozoic Eon, Paleoproterozoic Era, and Siderian Period start. Oxygen saturation in the oceans is reached: Banded iron formations form and saturate ocean floor deposits - without an oxygen sink,
Earth’s atmosphere becomes highly oxygenic. Great Oxygenation Event led by cyanobacteria's oxygenic photosynthesis - various forms of Archaea and anoxic bacteria become extinct in first great extinction event on Earth. Algoman Orogeny or Kenoran: assembly of Arctica out of the Canadian Laurentian Shield and Siberian craton - formation of Angaran Shield and Slave Province.

- c.2,440 Ma – Formation of Gawler Craton in Australia.
- c.2,400 Ma – Huronian glaciation starts, probably from oxidation of earlier methane greenhouse gas produced by burial of organic sediments of photosynthesizers. First cyanobacteria. Formation of Dharwar Craton in southern India.
- c.2,400 Ma – Suavjarvi impact structure forms. This is the oldest known impact crater whose remnants are still recognizable. Dharwar Craton in southern India stabilizes.

**Rhyacian Period**

- c.2,300 Ma – Rhyacian period starts.
- c.2,250 Ma – Bushveld Igneous Complex forms: world's largest reserves of platinum-group metals (platinum, palladium, osmium, iridium, rhodium and ruthenium), as well as vast quantities of iron, tin, chromium, titanium and vanadium appear – formation of Transvaal Basin begins.
- c.2,200–1800 Ma – Continental Red Beds found, produced by iron in weathered sandstone being exposed to oxygen. Eburnean Orogeny, series of tectonic, metamorphic and plutonic events establish Eglab Shield to the north of West African Craton and Man Shield to its south – Birimian domain of West Africa established and structured.
- c.2,200 Ma – Iron content of ancient fossil soils shows an oxygen built up to 5–18% of current levels. End of Kenoran Orogeny: invasion of Superior and Slave Provinces by basaltic dikes and sills – Wyoming and Montana arm of Superior Province experiences intrusion of 5 km thick sheet of chromite-bearing gabbroic rock as Stillwater Complex forms.
- c.2,100 Ma – Huronian glaciation ends. Earliest known eukaryote fossils found. Earliest multicellular organisms collectively referred to as the "Gabonionta" (Francevillian Group Fossil); Wopmay orogeny along western margin of Canadian Shield.
- c.2,090 Ma – Eburnean Orogeny: Eglab Shield experiences syntectonic trondhjemitic pluton intrusion of its Chegga series – most of the intrusion is in the form of a plagioclase called oligoclase.
- 2.070 Ma – Eburnean Orogeny: asthenospheric upwelling releases large volume of post-orogenic magmas – magma events repeatedly reactivated from the Neoproterozoic to the Mesozoic.

**Orosirian Period**

- c.2,050 Ma – Orosirian Period starts. Significant orogeny in most continents.
- c.2,023 Ma – Vredefort impact structure forms.
- c.2,005 Ma – Glenburgh Orogeny (to c.1,920 Ma) begins: Glenburgh Terrane in western Australia begins to stabilize during period of substantial granite magmatism and deformation; Halfway Gneiss and Moogie Metamorphics result. Dalgaringa Supersuite (to c.1,985 Ma), comprising sheets, dykes and viens of mesocratic and leucocratic tonalite, stabilizes.
- c.2,000 Ma – The lesser supercontinent Atlantica forms. The Oklo natural nuclear reactor of Gabon produced by uranium-precipitant bacteria. First acritarchs.
- c.1,900 - 1,880 Ma – Gunflint chert biota forms flourishes including prokaryotes like Kakabekia, Gunflintia, Animikiea and Eoastrion
- c.1,850 Ma – Sudbury impact structure. Penokean orogeny. First eukaryotes. Bacterial viruses (bacteriophage) emerge before, or soon after, the divergence of the prokaryotic and eukaryotic lineages.
- c.1,830 Ma – Capricorn Orogeny (1.83 - 1.78 Gyr) stabilizes central and northern Gascoyne Complex: formation of pelitic and psammitic schists known as Morrissey Metamorphics and depositing Pooranoo Metamorphics an amphibolite facies

**Statherian Period**

- c.1,800 Ma – Statherian Period starts. Supercontinent Columbia forms, one of whose fragments being Nena. Oldest ergs develop on several cratons Barramundi Orogeny (ca. 1.8 Gyr) influences MacArthur Basin in Northern Australia.
- c.1,780 Ma – Colorado Orogeny (1.78 - 1.65 Gyr) influences southern margin of Wyoming craton - collision of Colorado orogen and Trans-Hudson orogen with stabilized Archean craton structure
- c.1,770 Ma – Big Sky Orogeny (1.77 Gyr) influences southwest Montana: collision between Hearne and Wyoming cratons
- c.1,765 Ma – As Kimban Orogeny in Australian continent slows, Yapungku Orogeny (1.765 Gyr) begins affecting Yilgarn craton in Western Australia - possible formation of Darling Fault, one of longest and most significant in Australia
- c.1,760 Ma – Yavapai Orogeny (1.76 - 1.7 Gyr) impacts mid- to south-western United States
- c.1,750 Ma – Gothian Orogeny (1.75 - 1.5 Gyr): formation of tonalitic-granodioritic plutonic rocks and calc-alkaline volcanites in the East European Craton
- c.1,700 Ma – Stabilization of second major continental mass, the Guiana Shield in South America
- c.1,680 Ma – Mangarooon Orogeny (1.68 - 1.62 Gyr), on the Gascoyne Complex in Western Australia: Durlacher Supersuite, granite intrusion featuring a northern (Minnie Creek) and southern belt - heavily sheared orthoclase porphyroclastic granites
• c.1,650 Ma – Kararan Orogeny (1.65 Gyr) uplifts great mountains on the Gawler Craton in Southern Australia - formation of Gawler Range including picturesque Conical Hill Track and "Organ Pipes" waterfall

Mesoproterozoic Era

Calymmian Period

• c.1,600 Ma – Mesoproterozoic Era and Calymmian Period start. Platform covers expand. Major orogenic event in Australia: Isan Orogeny influences Mount Isa Block of Queensland - major deposits of lead, silver, copper and zinc are laid down. Mazatzal Orogeny (to c.1,300 Ma) influences mid- to south-western United States: Precambrian rocks of the Grand Canyon, Vishnu Schist and Grand Canyon Series, are formed establishing basement of Canyon with metamorphosed gneisses that are intruded by granites. Belt Supergroup in Montana/Idaho/BC formed in basin on edge of Laurentia.

• c.1,500 Ma – Supercontinent Columbia splits apart: associated with continental rifting along western margin of Laurentia, eastern India, southern Baltica, southeastern Siberia, northwestern South Africa and North China Block - formation of Ghats Province in India. First structurally complex eukaryotes (Hododyskia, colonial formamiferian?).

Ectasian Period

• c.1,400 Ma – Ectasian Period starts. Platform covers expand. Major increase in Stromatolite diversity with widespread blue-green algae colonies and reefs dominating tidal zones of oceans and seas

• c.1,300 Ma – Break-up of Columbia Supercontinent completed: widespread anorogenic magmatic activity, forming anorthosite-mangerite-charnockite-granite suites in North America, Baltica, Amazonia and North China - stabilization of Amazonian Craton in South America Grenville orogeny(to c.1,000 Ma) in North America: globally associated with assembly of Supercontinent Rodinia establishes Grenville Province in Eastern North America - folded mountains from Newfoundland to North Carolina as Old Rag Mountain forms

• c.1,270 Ma – Emplacement of Mackenzie granite mafic dike swarm - one of three dozen dike swarms, forms into Mackenzie Large Igneous Province - formation of Copper Creek deposits

• c.1,250 Ma – Sveconorwegian Orogeny (to c.900 Ma) begins: essentially a reworking of previously formed crust on the Baltic Shield

• c.1,240 Ma – Second major dike swarm, Sudbury dikes form in Northeastern Ontario around the area of the Sudbury Basin
Stenian Period


- c.1,100 Ma – First dinoflagellate evolve: photosynthetic some develop mixotrophic habits ingesting prey - with their appearance, prey-predator relationship is established for first time forcing acritarchs to defensive strategies and leading to open "arms" race. Late Ruker (1.1 - 1 Gyr) and Nimrod Orogenies (1.1 Gyr) in Antarctica possibly begins: formation of Gamburtsev mountain range and Vostok Subglacial Highlands. Keweenawan Rift buckles in the south-central part of the North American plate - leaves behind thick layers of rock that are exposed in Wisconsin, Minnesota, Iowa and Nebraska and creates rift valley where future Lake Superior develops.

- c.1,080 Ma – Musgrave Orogeny (ca. 1.080 Gyr) forms Musgrave Block, an east-west trending belt of granulite-gneiss basement rocks - voluminous Kulgera Suite of granite and Birksgate Complex solidify.

- c.1,076 Ma – Musgrave Orogeny: Warakurna large igneous province develops - intrusion of Giles Complex and Winburn Suite of granites and deposition of Bentley Supergroup (including Tollu and Smoke Hill Volcanics).

Neoproterozoic Era

Tonian Period

- c.1,000 Ma – Neoproterozoic Era and Tonian Period start. Grenville orogeny ends. First radiation of dinoflagellates and spiny acritarchs - increase in defensive systems indicate that acritarchs are responding to carnivorous habits of dinoflagellates - decline in stromatolite reef populations begins. Rodinia starts to break up. First vaucharian algae. Rayner Orogeny as proto-India and Antarctica collide (to c.900 Ma).

- c.920 Ma – Edmundian Orogeny (ca. 920 - 850 Myr) redefines Gascoyne Complex: consists of reactivation of earlier formed faults in the Gascoyne - folding and faulting of overlying Edmund and Collier basins.

- c.920 Ma – Adelaide Geosyncline laid down in central Australia - essentially a rift complex, consists of thick layer of sedimentary rock and minor volcanics deposited on Easter margin - limestones, shales and sandstones predominate.
• c.900 Ma – Bitter Springs Formation of Australia: in addition to prokaryote assemblage of fossils, cherts include eukaryotes with ghostly internal structures similar to green algae - first appearance of Glenobotrydion (900 - 720 Myr), among earliest plants on Earth

• c.830 Ma – Rift develops on Rodinia between continental masses of Australia, eastern Antarctica, India, Congo and Kalahari on one side and Laurentia, Baltica, Amazonia, West African and Rio de la Plata cratons on other - formation of Adamastor Ocean.

• c.800 Ma – With free oxygen levels much higher, carbon cycle is disrupted and once again glaciation becomes severe - beginning of second "snowball Earth" event

• c.750 Ma – First Protozoa appears: as creatures like Paramecium, Amoeba and Melanocyrillium evolve, first animal-like cells become distinctive from plants - rise of herbivores (plant feeders) in the food chain. First Sponge-like animal: similar to early colonial foraminiferan Horodyskia, earliest ancestors of Sponges were colonial cells that circulated food sources using flagella to their gullet to be digested. Kaigas (c.750 Ma): first thought to be a major glaciation of Earth, however, the Kaigas formation was later determined to be non-glacial.

**Cryogenian Period**

• c.720 Ma – Cryogenian Period starts, during which Earth freezes over (Snowball Earth or Slushball Earth) at least 3 times. The Sturtian glaciation continues the process begun during Kaigas - great ice sheets cover most of the planet stunting evolutionary development of animal and plant life - survival based on small pockets of heat under the ice.

• c.700 Ma – Fossils of testate Amoeba first appear: first complex metazoans leave unconfirmed biomarkers - they introduce new complex body plan architecture which allows for development of complex internal and external structures. Worm trail impressions in China: because putative "burrows" under stromatolite mounds are of uneven width and tapering makes biological origin difficult to defend - structures imply simple feeding behaviours. Rifting of Rodinia is completed: formation of new superocean of Panthalassa as previous Mirovia ocean bed closes - Mozambique mobile belt develops as a suture between plates on Congo-Tanzania craton

• c.660 Ma – As Sturtian glaciers retreat, Cadomian orogeny (660 - 540 Myr) begins on north coast of Armorica: involving one or more collisions of island arcs on margin of future Gondwana, terranes of Avalonia, Armorica and Ibera are laid down

• c.650 Ma – First Demosponges appear: form first skeletons of spicules made from protein spongin and silica - brightly coloured these colonial creatures filter feed since they lack nervous, digestive or circulatory systems and reproduce both sexually and asexually
• c.650 Ma – Final period of worldwide glaciation, Marinoan (650 - 635 Myr) begins: most significant "snowball Earth" event, global in scope and longer - evidence from Diamictite deposits in South Australia laid down on Adelaide Geosyncline

Ediacaran Period

• c.635 Ma – Ediacaran period begins. End of Marinoan Glaciation: last major "snowball Earth" event as future ice ages will feature less overall ice coverage of the planet
• c.633 Ma – Beardmore Orogeny (to c.620 Ma) in Antarctica: reflection of final break-up of Rodinia as pieces of the supercontinent begin moving together again to form Pannotia
• c.620 Ma – Timanide Orogeny (to c.550 Ma) affects northern Baltic Shield: gneiss province divided into several north-south trending segments experiences numerous metasedimentary and metavolcanic deposits - last major orogenic event of Precambrian
• c.600 Ma – Pan-African Orogeny begins: Arabian-Nubian Shield formed between plates separating supercontinent fragments Gondwana and Pannotia - Supercontinent Pannotia (to c.500 Ma) completed, bordered by Iapetus and Panthalassa oceans. Accumulation of atmospheric oxygen allows for the formation of ozone layer: prior to this, land-based life would probably have required other chemicals to attenuate ultraviolet radiation enough to permit colonization of the land
• c.575 Ma – First Ediacaran-type fossils.
• c.565 Ma - Charnia, a frond-like organism, first evolves.
• c.560 Ma – Trace fossils, e.g., worm burrows, and small bilaterally symmetrical animals. Earliest arthropods. Earliest fungi.
• c.558 Ma - Dickinsonia, a large slow moving disc-like creature, first appears - the discovery of fat molecules in its tissues make it the first confirmed true metazoan animal of the fossil record.
• c.555 Ma – The first possible mollusk Kimberella appears.
• c.550 Ma – First possible comb-jellies, sponges, corals, and anemones.
• c.550 Ma - Uluru or Ayers Rock begins forming during the Petermann Orogeny in Australia
• c.544 Ma – The small shelly fauna first appears.

Phanerozoic Eon

Paleozoic Era

Cambrian Period
• c.541 ± 1.0 Ma – beginning of the Cambrian Period, the Paleozoic Era and the current Phanerozoic Eon.
  End of the Ediacaran Period, the Proterozoic Eon and the Precambrian Supereon. The Ediacaran fauna disappears, while the Cambrian explosion initiates the emergence of most forms of complex life, including vertebrates (fish), arthropods, echinoderms and molluscs. Pannotia breaks up into several smaller continents: Laurentia, Baltica and Gondwana.
• c.540 Ma – Supercontinent of Pannotia breaks up.
• c.530 Ma – First fish - appearance of Myllokunmingia
• c.525 Ma – First graptolites.
• c.521 Ma – First trilobites.
• c.518 Ma - Chengjiang biota flourishes - Maotianshan Shales reveal numerous invertebrates and arthropods that appear in the Burgess shales suggesting their range is global and includes a number of chordates including Haikouella, Yunnanozoon and early fish like Haikouichthys.
• c.514 Ma - Paradoxides trilobites appear, the largest members of the Cambrian Trilobites.
• c.511 Ma - Earliest crustaceans.
• c.505 Ma – Deposition of the Burgess Shale - Biota includes numerous strange invertebrates and arthropods like Opabinia; First great apex predator Anomalocaris dominates.
• c.490 Ma - Beginning of the Caledonian Orogeny as three continents and terranes of Laurentia, Baltica and Avalonia collide resulting in mountain-building recorded in the northern parts of Ireland and Britain, the Scandinavian Mountains, Svalbard, eastern Greenland and parts of north-central Europe.
• c.488 Ma - Earliest brittle stars.

Ordovician Period

• c.485.4 ± 1.7 Ma – Beginning of the Ordovician and the end of the Cambrian Period.
• c.485 Ma – First jawless fish - radiation of Thelodont fish into the Silurian
• c.460 Ma - First crinoids evolve.
• c.450 Ma - Late Ordovician microfossils of scales indicate the earliest evidence for the existence of jawed fish or Gnathostomata.
• c.450 Ma – Plants and arthropods colonize the land. Sharks evolve. First horseshoe crabs and starfish.

Silurian Period

• c.443.8 ± 1.5 Ma – Beginning of the Silurian and the end of the Ordovician Period.
c.433 Ma - Great Glen Fault begins shaping the Scottish Highlands as the Caledonian Orogeny reaches its close.

c.430 Ma - First appearance of Cooksonia the oldest known plant to have a stem with vascular tissue and is thus a transitional form between the primitive non-vascular bryophytes and the vascular plants.

c.420 Ma – First creature took a breath of air. First ray-finned fish and land scorpions.

c.410 Ma – First toothed fish and nautiloids.

Devonian Period

- c.419.2 ± 2.8 Ma – Beginning of the Devonian and end of the Silurian Period. First insects.
- c.419 Ma - Old Red Sandstone sediments begin being laid in the North Atlantic region including, Britain, Ireland, Norway and in the west along the northeastern seaboard of North America. It also extends northwards into Greenland and Svalbard.
- c.415 Ma - Cephalaspis, an iconic member of the Osteostraci, appears, the most advanced of the jawless fish. Its boney armor serves as protection against the successful radiation of Placoderms and as a way to live in calcium-poor fresh water environments.
- c.395 Ma – First of many modern groups, including tetrapods.
- c.375 Ma - Acadian Orogeny begins influencing mountain building along the Atlantic seaboard of North America.
- c.370 Ma - Cladoselache, an early shark, first appears.
- c.363 Ma - Vascular plants begin to create the earliest stable soils on land.
- c.360 Ma – First crabs and ferns. The large predatory lobe-finned fish Hyneria evolves.
- c.350 Ma – First large sharks, ratfish and hagfish.

Carboniferous Period

- c.358.9 ± 2.5 Ma – Beginning of the Carboniferous and the end of Devonian Period. Amphibians diversify.
- c.345 Ma - Agaricocrinus americanus a representative of the Crinoids appears as part of a successful radiation of the echinoderms.
- c.330 Ma – First amniotes evolve.
- c.320 Ma – First synapsids evolve.
- c.318 Ma - First beetles.
- c.315 Ma – The evolution of the first reptiles.
- c.312 Ma - Hylonomus makes first appearance, one of the oldest reptiles found in the fossil record.
• c.306 Ma - Diplocaulus evolves in the swamps with an unusual boomerang-like skull.
• c.305 Ma – First diapsids evolve; Meganeura, a giant dragonfly, dominates the skies.
• c.300 Ma - Last great period of mountain building episodes in Europe and North America in response to the final suturing together of the supercontinent Pangaea - the Ural mountains are uplifted

Permian Period

• c.298.9 ± 0.8 Ma – End of Carboniferous and beginning of Permian Period. By this time, all continents have fused into the supercontinent of Pangaea. Seed plants and conifers diversify along with temnospondyls and pelycosaurs.
• c.296 Ma - Oldest known octopus fossil.
• c.295 Ma - Dimetrodon evolves.
• c.280 Ma - First cycads evolve.
• c.275 Ma – First therapsids evolve.
• c.270 Ma - Gorgonopsians, the apex predators of the Late Permian, first evolve.
• c.251.4 Ma – Permian mass extinction. End of Permian Period and of the Palaeozoic Era. Beginning of Triassic Period, the Mesozoic era and of the age of the dinosaurs.

Mesozoic Era

Triassic Period

• c.251.902 ± 0.4 Ma – Mesozoic era and Triassic Period begin. Mesozoic Marine Revolution begins.
• c.245 Ma – First ichthyosaurs.
• c.240 Ma – Cynodonts and rhynchosaurs diversify.
• c.225 Ma – First dinosaurs and teleosts evolve.
• c.220 Ma – First crocodilians and flies.
• c.215 Ma – First turtles. Long-necked sauropod dinosaurs and Coelophysis, one of the earliest theropod dinosaurs, evolve. First mammals.
• c.210 Ma - Earliest elasmosauridae.

Jurassic Period

• c.201.3 ± 0.6 Ma – Triassic-Jurassic extinction event marks the end of Triassic and beginning of Jurassic Period. The largest dinosaurs, such as Diplodocus and Brachiosaurus evolve during this time, as
do the carnosaurs; large, bipedal predatory dinosaurs such as *Allosaurus*. First specialized pterosaurs and sauropods. Ornithischians diversify.

- c.199 Ma - First squamata evolve. Earliest lizards.
- c.190 Ma – Pliosaurs evolve, along with many groups of primitive sea invertebrates.
- c.180 Ma – Pangaea splits into two major continents: Laurasia in the north and Gondwana in the south.
- c.176 Ma – First stegosaurs.
- c.170 Ma – First salamanders and newts evolve. Cynodonts go extinct.
- c.165 Ma – First rays and glycymeridid bivalves.
- c.164 Ma - The first gliding mammal, *volaticotherium*, appears in the fossil record.
- c.161 Ma – First ceratopsians.
- c.155 Ma – First birds and triconodonts. Stegosaurus and theropods diversify.
- c.153 Ma - Earliest pine trees.

**Cretaceous Period**

- c.145 ± 4 Ma – End of Jurassic and beginning of Cretaceous Period.
- c.145 Ma - First mantises.
- c.140 Ma - Earliest orb-weaver spiders evolve.
- c.130 Ma – Laurasia and Gondwana begin to split apart as the Atlantic Ocean forms. First flowering plants. Earliest anglerfish.
- c.125 Ma - *Sinodelphys szalayi*, the earliest known marsupial, evolves in China.
- c.122 Ma - Earliest ankylosauridae.
- c.115 Ma – First monotremes.
- c.110 Ma – First hesperornithes.
- c.106 Ma – Spinosaurus evolves.
- c.100 Ma – First bees.
- c.94 Ma - First modern species of palm trees appear.
- c.90 Ma – the Indian subcontinent splits from Gondwana, becoming an island continent. Ichthyosaurs go extinct. Snakes and ticks evolve.
- c.86 Ma - First hadrosauridae.
- c.80 Ma – Australia splits from Antarctica. First ants.
- c.75 Ma - First velociraptors.
• c.70 Ma – Multituberculates diversify. The Mosasaurus evolves.
• c.68 Ma – Tyrannosaurus rex evolves. Earliest species of Triceratops. Quetzalcoatlus, one of the largest flying animals to ever live, first appears in the fossil record.
• c.66.038 ± 0.011 Ma – Cretaceous-Paleogene extinction event at the end of the Cretaceous Period marks the end of the Mesozoic era and the age of the dinosaurs; start of the Paleogene Period and the current Cenozoic era.

Cenozoic Era

Paleogene Period

• c.63 Ma – First creodonts.
• c.62 Ma - First penguins.
• c.60 Ma – Evolution of the first primates and miacids. Flightless birds diversify.
• c.56 Ma – Gastornis evolves.
• c.55 Ma – the island of the Indian subcontinent collides with Asia, thrusting up the Himalayas and the Tibetan Plateau. Many modern bird groups appear. First whale ancestors. First rodents, lagomorphs, armadillos, sirenians, proboscideans, perissodactyls, artiodactyls, and mako sharks. Angiosperms diversify.
• c.52.5 Ma - First passerine (perching) birds.
• c.52 Ma – First bats.
• c.50 Ma – Africa collides with Eurasia, closing the Tethys Sea. Divergence of cat and dog ancestors. Primates diversify. Brontotheres, tapirs, and rhinos evolve.
• c.49 Ma – Whales return to the water.
• c.45 Ma - Camels evolve in North America.
• c.40 Ma – Age of the Catarrhini parvorder; first canines evolve. Lepidopteran insects become recognizable. Gastornis goes extinct. Basilosaurus evolves.
• c.37 Ma – First Nimravids.
• c.33.9 ± 0.1 Ma – End of Eocene, start of Oligocene epoch.
• c.35 Ma – Grasslands first appear. Glyptodonts, ground sloths, peccaries, dogs, eagles, and hawks evolve.
• c.33 Ma – First thylacinid marsupials evolve.
• c.30 Ma – Brontotheres go extinct. Pigs evolve. South America separates from Antarctica, becoming an island continent.
• c.28 Ma – Paraceratherium evolves. First pelicans.
- c.26 Ma – Emergence of the first true elephants.
- c.25 Ma – First deer. Cats evolve.
- c.24 Ma - Earliest pinnipeds (seals).

**Neogene Period**

- c.23.03 ± 0.05 Ma – Neogene Period and Miocene epoch begin
- c.22 Ma - First hyenas.
- c.20 Ma – Giraffes and giant anteaters evolve.
- c.18-12 Ma – estimated age of the *Hominidae/Hylobatidae* (great apes vs. gibbons) split.
- c.16 Ma - The hippopotamus evolves.
- c.15 Ma – First mastodons, bovids, and kangaroos. Australian megafauna diversify.
- c.10 Ma – Insects diversify. First large horses. Camels cross from America to Asia.
- c.6.5 Ma – First members of the Hominini tribe.
- c.6 Ma – Australopithecines diversify.
- c.5.96 Ma – 5.33 Ma – Messinian Salinity Crisis: the precursor of the current Strait of Gibraltar closes repeatedly, leading to a partial desiccation and strong increase in salinity of the Mediterranean Sea.
- c.5.4-6.3 Ma – Estimated age of the *Homo/Pan* (human vs. chimpanzee) split.
- c.5.5 Ma – Appearance of the genus *Ardipithecus*
- c.5.33 Ma – Zanclean flood: the Strait of Gibraltar opens for the last (and current) time and water from the Atlantic Sea fills again the Mediterranean Sea basin.
- c.5.333 ± 0.005 Ma – Pliocene epoch begins. First tree sloths. First large vultures. Nimravids go extinct.
- c.4.8 Ma – The mammoth appears.
- c.4.5 Ma – appearance of the genus *Australopithecus*
- c.4 Ma - First zebras.
- c.3 Ma – Isthmus of Panama joins North and South America. Great American Interchange. Cats, condors, raccoons and camelids move south; armadillos, hummingbirds, and opossums move north.
- c.2.7 Ma – Paranthropus evolves.
- c.2.6 Ma – The current ice age begins.

**Quaternary Period**
- c.2.58 ± 0.005 Ma – start of the Pleistocene epoch, the Stone Age and the current Quaternary Period; emergence of the genus *Homo*. Smilodon, the best known of the sabre-toothed cats, appears.
- c.1.9 Ma – Oldest known *Homo erectus* fossils. This species might be evolved some time before, up to c.2 Ma ago.
- c.1.7 Ma – Australopithecines go extinct.
- c.1.8-0.8 Ma – colonisation of Eurasia by *Homo erectus*.
- c.1.5 Ma – earliest possible evidence of the controlled use of fire by *Homo erectus*.
- c.1.2 Ma – Homo antecessor evolves. Paranthropus dies out.
- c.0.79 Ma – earliest demonstrable evidence of the controlled use of fire by *Homo erectus*.
- c.0.7 Ma – last reversal of the earth's magnetic field.
- c.0.7 Ma: oldest archaic hominins that broke away from the modern human lineage that were found to have inserted into the Sub-Saharan African population genome approximately 35,000 years ago.
- c.0.64 Ma – Yellowstone caldera erupts.
- c.0.6 Ma – Homo heidelbergensis evolves.
- c.0.5 Ma - First brown bears.
- c.0.315 Ma – Middle Paleolithic begins. Appearance of *Homo sapiens* in Africa.

**Timeline of epochs in cosmology**

- c. 0 seconds (13.799 ± 0.021 Gya): Planck Epoch begins: earliest meaningful time. The Big Bang occurs in which ordinary space and time develop out of a primeval state (possibly a virtual particle or false vacuum) described by a quantum theory of gravity or "Theory of Everything". All matter and energy of the entire visible universe is contained in a hot, dense point (gravitational singularity), a billionth the size of a nuclear particle. This state has been described as a particle desert. Other than a few scant details, conjecture dominates discussion about the earliest moments of the universe's history since no effective means of testing this far back in space-time is presently available. WIMPS (weakly interacting massive particles) or dark matter and dark energy may have appeared and been the catalyst for the expansion of the singularity. The infant universe cools as it begins expanding outward. It is almost completely smooth, with quantum variations beginning to cause slight variations in density.
- c. 10^-43 seconds: Grand unification epoch begins: While still at an infinitesimal size, the universe cools down to 10^32 kelvin. Gravity separates and begins operating on the universe—the remaining fundamental forces stabilize into the electronuclear force, also known as the Grand Unified Force or Grand Unified
Theory (GUT), mediated by (the hypothetical) X and Y bosons which allow early matter at this stage to fluctuate between baryon and lepton states.

- c. $10^{-36}$ seconds: Electroweak epoch begins: The Universe cools down to $10^{28}$ kelvin. As a result, the strong nuclear force becomes distinct from the electroweak force perhaps fuelling the inflation of the universe. A wide array of exotic elementary particles result from decay of X and Y bosons which include W and Z bosons and Higgs bosons.

- c. $10^{-33}$ seconds: Space is subjected to inflation, expanding by a factor of the order of $10^{20}$ over a time of the order of $10^{-33}$ to $10^{-32}$ seconds. The universe is supercooled from about $10^{27}$ down to $10^{22}$ kelvin.

- c. $10^{-32}$ seconds: Cosmic inflation ends. The familiar elementary particles now form as a soup of hot ionized gas called quark-gluon plasma; hypothetical components of cold dark matter (such as axions) would also have formed at this time.

- c. $10^{-12}$ seconds: Electroweak phase transition: the four fundamental interactions familiar from the modern universe now operate as distinct forces. The weak nuclear force is now a short-range force as it separates from electromagnetic force, so matter particles can acquire mass and interact with the Higgs Field. The temperature is still too high for quarks to coalesce into hadrons, and the quark-gluon plasma persists (Quark epoch). The universe cools to $10^{15}$ kelvin.

- c. $10^{-11}$ seconds: Baryogenesis may have taken place with matter gaining the upper hand over anti-matter as baryon to antibaryon constituencies are established.

- c. $10^{-6}$ seconds: Hadron epoch begins: As the universe cools to about $10^{10}$ kelvin, a quark-hadron transition takes place in which quarks bind to form more complex particles—hadrons. This quark confinement includes the formation of protons and neutrons (nucleons), the building blocks of atomic nuclei.

- c. 1 second: Lepton epoch begins: The universe cools to $10^{9}$ kelvin. At this temperature, the hadrons and antihadrons annihilate each other, leaving behind leptons and antileptons – possible disappearance of antiquarks. Gravity governs the expansion of the universe: neutrinos decouple from matter creating a cosmic neutrino background.

- c. 10 seconds: Photon epoch begins: Most of the leptons and antileptons annihilate each other. As electrons and positrons annihilate, a small number of unmatched electrons are left over – disappearance of the positrons.

- c. 10 seconds: Universe dominated by photons of radiation – ordinary matter particles are coupled to light and radiation while dark matter particles start building non-linear structures as dark matter halos. Because charged electrons and protons hinder the emission of light, the universe becomes a super-hot glowing fog.

- c. 3 minutes: Primordial nucleosynthesis: nuclear fusion begins as lithium and heavy hydrogen (deuterium) and helium nuclei form from protons and neutrons.
• c. 20 minutes: Nuclear fusion ceases: normal matter consists of 75% hydrogen nuclei and 25% helium nuclei – free electrons begin scattering light.

• c. 47,000 years (z=3600): Matter and radiation equivalence: at the beginning of this era, the expansion of the universe was decelerating at a faster rate.

• c. 70,000 years: Matter domination in Universe: onset of gravitational collapse as the Jeans length at which the smallest structure can form begins to fall.

• c. 370,000 years (z=1,100): The "Dark Ages" is the period between decoupling, when the universe first becomes transparent, until the formation of the first stars. Recombination: electrons combine with nuclei to form atoms, mostly hydrogen and helium. Distributions of hydrogen and helium at this time remains constant as the electron-baryon plasma thins. The temperature falls to 3000 kelvin. Ordinary matter particles decouple from radiation. The photons present at the time of decoupling are the same photons that we see in the cosmic microwave background (CMB) radiation.

• c. 400,000 years: Density waves begin imprinting characteristic polarization (waves) signals.

• c. 10-17 million years: The "Dark Ages" span a period during which the temperature of cosmic background radiation cooled from some 4000 K down to about 60 K. The background temperature was between 373 K and 273 K, allowing the possibility of liquid water, during a period of about 7 million years, from about 10 to 17 million after the Big Bang (redshift 137–100). Loeb (2014) speculated that primitive life might in principle have appeared during this window, which he called "the Habitable Epoch of the Early Universe".

• c. 100 million years: Gravitational collapse: ordinary matter particles fall into the structures created by dark matter. Reionization begins: smaller (stars) and larger non-linear structures (quasars) begin to take shape – their ultraviolet light ionizes remaining neutral gas.

• 200–300 million years: First stars begin to shine: Because many are Population III stars (some Population II stars are accounted for at this time) they are much bigger and hotter and their life-cycle is fairly short. Unlike later generations of stars, these stars are metal free. As reionization intensifies, photons of light scatter off free protons and electrons – Universe becomes opaque again.

• 200 million years: HD 140283, the "Methuselah" Star, formed, the unconfirmed oldest star observed in the Universe. Because it is a Population II star, some suggestions have been raised that second generation star formation may have begun very early on. The oldest-known star (confirmed) – SMSS J031300.36-670839.3, forms.

• 300 million years: First large-scale astronomical objects, protogalaxies and quasars may have begun forming. As Population III stars continue to burn, stellar nucleosynthesis operates – stars burn mainly by fusing hydrogen to produce more helium in what is referred to as the main sequence. Over time these stars are forced to fuse helium to produce carbon, oxygen, silicon and other heavy elements up to iron on the periodic table. These elements, when seeded into neighbouring gas clouds by supernova, will lead to the formation of more Population II stars (metal poor) and gas giants.
- 380 million years: UDFj-39546284 forms, current record holder for unconfirmed oldest-known quasar.
- 400 million years (z=11): GN-z11, the oldest-known galaxy, forms.
- 420 million years: The quasar MACS0647-JD, the, or one of the, furthest known quasars, forms.
- 600 million years HE 1523-0901, the oldest star found producing neutron capture elements forms, marking a new point in ability to detect stars with a telescope.
- 630 million years (z=8.2): GRB 090423, the oldest gamma ray burst recorded suggests that supernovas may have happened very early on in the evolution of the Universe.
- 670 million years: EGS-zs8-1, the most distant starburst or Lyman-break galaxy observed, forms. This suggests that galaxy interaction is taking place very early on in the history of the Universe as starburst galaxies are often associated with collisions and galaxy mergers.
- 700 million years: Galaxies form. Smaller galaxies begin merging to form larger ones. Galaxy classes may have also begun forming at this time including Blazars, Seyfert galaxies, radio galaxies, and dwarf galaxies as well as regular types (elliptical, barred spiral, and spiral galaxies). UDFy-38135539, the first distant quasar to be observed from the reionization phase, forms. Dwarf galaxy z8 GND 5296 forms.
- 740 million years: 47 Tucanae, second-brightest globular cluster in the Milky Way, forms.
- 750 million years: Galaxy IOK-1 a Lyman alpha emitter galaxy, forms. GN-108036 forms—galaxy is 5 times larger and 100 times more massive than the present day Milky Way illustrating the size attained by some galaxies very early on.
- 770 million years: Quasar ULAS J1120+0641, one of the most distant, forms. One of the earliest galaxies to feature a supermassive black hole suggesting that such large objects existed quite soon after the Big Bang. The large fraction of neutral hydrogen in its spectrum suggests it may also have just formed or is in the process of star formation.
- 800 million years: Farthest extent of Hubble Ultra Deep Field. Formation of SDSS J102915+172927: unusual population II star that is extremely metal poor consisting of mainly hydrogen and helium. HE0107-5240, one of the oldest Population II stars, forms as part of a binary star system. LAE J095950.99+021219.1, the Bogwiggit Galaxy, one of the most remote Lyman alpha emitter galaxies, forms. Lyman alpha emitters are considered to be the progenitors of spiral galaxies like the Milky Way. Messier 2, globular cluster, forms.
- 870 million years: Messier 30 forms in the Milky Way. Having experienced a Core collapse (cluster), the cluster has one of the highest densities among globular clusters.
- 890 million years: Galaxy SXDF-NB1006-2 forms.
- 900 million years: Galaxy BDF-3299 forms.
- 910 million years: Galaxy BDF-521 forms
- 1 billion years (12.8 Gya, z=6.56): Galaxy HCM-6A, the most distant normal galaxy observed, forms. Formation of hyper-luminous quasar SDSS J0100+2802, which harbors a black hole with mass of 12 billion solar masses, one of the most massive black holes discovered so early in the universe. HE1327-2326, a population II star, is speculated to have formed from remnants of earlier Population III stars. Visual limit of the Hubble Deep Field. Reionization complete—the Universe becomes transparent again. Galaxy evolution continues as more modern looking galaxies form and develop. Because the Universe is still small in size, galaxy interactions become common place with larger and larger galaxies forming out of the galaxy merger process. Galaxies may have begun clustering creating the largest structures in the Universe so far - the first galaxy clusters and galaxy superclusters appear.
- 1.1 billion years (12.7 Gya): Age of the quasar CFHQs 1641+3755. Messier 4 Globular Cluster, first to have its individual stars resolved, forms in the halo of the Milky Way Galaxy. Among the clusters many stars, PSR B1620-26 b, a gas giant known as the "Genesis Planet" or "Methusaleh", orbiting a pulsar and a white dwarf, the oldest observed extrasolar planet in Universe, forms.
- 1.13 billion years (12.67 Gya): Messier 12, globular cluster, forms
- 1.3 billion years (12.5 Gya): WISE J224607.57-052635.0, a luminous infrared galaxy, forms. PSR J1719-1438 b, known as the Diamond Planet, forms around a pulsar.
- 1.31 billion years (12.49 Gya): Globular Cluster Messier 53 forms 60,000 light-years from the galactic centre of the Milky Way
- 1.39 billion years (12.41 Gya): S5 0014+81, a hyper-luminous quasar, forms
- 1.4 billion years (12.4 Gya): Age of Cayrel's Star, BPS C531082-0001, a neutron capture star, among the oldest Population II stars in Milky Way. Quasar RD1, first object observed to exceed redshift 5, forms.
- 1.44 billion years (12.36 Gya): Messier 80 globular cluster forms in Milky Way - known for large number of "blue stragglers"
- 1.5 billion years (12.3 Gya): Messier 55, globular cluster, forms
- 1.8 billion years (12 Gya): Most energetic gamma ray burst lasting 23 minutes, GRB 080916C, recorded. Baby Boom Galaxy forms. Terzan 5 forms as a small dwarf galaxy on collision course with the Milky Way. Dwarf galaxy carrying the Methusaleh Star consumed by Milky Way – oldest-known star in the Universe becomes one of many population II stars of the Milky Way
- 2.0 billion years (11.8 Gya): SN 1000+0216, the oldest observed supernova occurs – possible pulsar formed. Globular Cluster Messier 15, known to have an intermediate black hole and the only globular cluster observed to include a planetary nebula, Pease 1, forms
- 2.02 billion years (11.78 Gya): Messier 62 forms – contains high number of variable stars (89) many of which are RR Lyrae stars.
2.2 billion years (11.6 Gya): Globular Cluster NGC 6752, third-brightest, forms in Milky Way

2.4 billion years (11.4 Gya): Quasar PKS 2000-330 forms.

2.41 billion years (11.39 Gya): Messier 10 globular cluster forms. Messier 3 forms: prototype for the Oosterhoff type I cluster, which is considered "metal-rich". That is, for a globular cluster, Messier 3 has a relatively high abundance of heavier elements.

2.5 billion years (11.3 Gya): Omega Centauri, largest globular cluster in the Milky Way forms

3.0 billion years (10.8 billion Gya): Formation of the Gliese 581 planetary system: Gliese 581c, the first observed ocean planet and Gliese 581d, a super-earth planet, possibly the first observed habitable planets, form. Gliese 581d has more potential for forming life since it is the first exoplanet of terrestrial mass proposed that orbits within the habitable zone of its parent star.

3.3 billion years (10.5 Gya): BX442, oldest grand design spiral galaxy observed, forms

3.5 billion years (10.3 Gya): Supernova SN UDS10Wil recorded

3.8 billion years (10 Gya): NGC 2808 globular cluster forms: 3 generations of stars form within the first 200 million years.

4.0 billion years (9.8 Gya): Quasar 3C 9 forms. The Andromeda Galaxy forms from a galactic merger - begins a collision course with the Milky Way. Barnard's Star, red dwarf star, may have formed. Beethoven Burst GRB 991216 recorded. Gliese 677 Cc, a planet in the habitable zone of its parent star, Gliese 667, forms

4.5 billion years (9.3 Gya): Fierce star formation in Andromeda making it into a luminous infra-red galaxy

5.0 billion years (8.8 Gya): Earliest Population I, or Sunlike stars: with heavy element saturation so high, planetary nebula appear in which rocky substances are solidified – these nurseries lead to the formation of rocky terrestrial planets, moons, asteroids, and icy comets

5.1 billion years (8.7 Gya): Galaxy collision: spiral arms of the Milky Way form leading to major period of star formation.

5.3 billion years (8.5 Gya): 55 Cancri B, a "hot Jupiter", first planet to be observed orbiting as part of a star system, forms. Kepler 11 planetary system, the flattest and most compact system yet discovered, forms – Kepler 11 c considered to be a giant ocean planet with hydrogen-helium atmosphere.

5.8 billion years (8 Gya): 51 Pegasi b also known as Bellerophon, forms – first planet discovered orbiting a main sequence star

5.9 billion years (7.9 Gya): HD 176051 planetary system, known as the first observed through astrometrics, forms

6.0 billion years (7.8 Gya): Many galaxies like NGC 4565 become relatively stable – ellipticals result from collisions of spirals with some like IC 1101 being extremely massive.
- 6.0 billion years (7.8 Gya): The Universe continues to organize into larger wider structures. The great walls, sheets and filaments consisting of galaxy clusters and superclusters and voids crystallize. How this crystallization takes place is still conjecture. Certainly, it is possible the formation of super-structures like the Hercules-Corona Borealis Great Wall may have happened much earlier, perhaps around the same time galaxies first started appearing. Either way the observable universe becomes more modern looking.

- 6.2 billion years (7.7 Gya): 16 Cygni Bb, the first gas giant observed in a single star orbit in a trinary star system, forms – orbiting moons considered to have habitable properties or at the least capable of supporting water

- 6.3 billion years (7.5 Gya, z=0.94): GRB 080319B, farthest gamma ray burst seen with the naked eye, recorded. Terzan 7, metal-rich globular cluster, forms in the Sagittarius Dwarf Elliptical Galaxy

- 6.5 billion years (7.3 Gya): HD 10180 planetary system forms (larger than both 55 Cancri and Kepler 11 systems)

- 6.9 billion years (6.9 Gya): Orange Giant, Arcturus, forms

- 7 billion years (6.8 Gya): North Star, Polaris, one of the significant navigable stars, forms

- 7.64 billion years (6.16 Gya): Mu Arae planetary system forms: of four planets orbiting a yellow star, Mu Arae c is among the first terrestrial planets to be observed from Earth

- 7.8 billion years (6.0 Gya): Formation of Earth's near twin, Kepler 452b orbiting its parent star Kepler 452

- 7.98 billion years (5.82 Gya): Formation of Mira or Omicron ceti, binary star system. Formation of Alpha Centauri Star System, closest star to the Sun – formation of Alpha Centauri Bb closest planet to the Sun. GJ 1214 b, or Gliese 1214 b, potential earth-like planet, forms

- 8.08-8.58 billion years (5.718-5.218 Gya): Capella star system forms

- 8.2 billion years (5.6 Gya): Tau Ceti, nearby yellow star forms: five planets eventually evolve from its planetary nebula, orbiting the star – Tau Ceti e considered planet to have potential life since it orbits the hot inner edge of the star's habitable zone

- 8.5 billion years (5.3 Gya): GRB 101225A, the "Christmas Burst", considered the longest at 28 minutes, recorded

- 8.8 billion years (5 Gya, z=0.5): Acceleration: dark-energy dominated era begins, following the matter-dominated era during which cosmic expansion was slowing down.

- 8.8 billion years (5 Gya): Messier 67 open star cluster forms: Three exoplanets confirmed orbiting stars in the cluster including a twin of our Sun.

- 9.0 billion years (4.8 Gya): Lalande 21185, red dwarf in Ursa Major, forms.

- 9.13 billion years (4.67 Gya): Proxima Centauri forms completing the Alpha Centauri trinary system.

- 9.2 billion years (4.6–4.57 Gya): Primal supernova, possibly triggers the formation of the Solar System.

- 9.23283 billion years (4.56717–4.55717 Gya): Four Jovian planets (Jupiter, Saturn, Uranus, Neptune) evolve around the sun.

- 9.257 billion years (4.543–4.5 Gya): Solar System of Eight planets, four terrestrial (Mercury, Venus, Earth, Mars) evolve around the sun. Because of accretion many smaller planets form orbits around the proto-Sun some with conflicting orbits – Early Bombardment Phase begins. Precambrian Supereon and Hadean eon begin on the Earth. Pre-Noachian Era begins on Mars. Pre-Tolstojan Period begins on Mercury – a large planetoid strikes Mercury stripping it of outer envelope of original crust and mantle, leaving the planet's core exposed – Mercury's iron content is notably high. Vega, fifth-brightest star in our galactic neighbourhood, forms. Many of the Galilean moons may have formed at this time including Europa and Titan which may presently be hospitable to some form of living organism.

- 9.266 billion years (4.533 Gya): Formation of Earth-Moon system following giant impact by hypothetical planetoid Theia (planet). Moon's gravitational pull helps stabilize Earth's fluctuating axis of rotation. Pre-Nectarian Period begins on Moon

- 9.271 billion years (4.529 Gya): Major collision with a pluto-sized planetoid establishes the Martian dichotomy on Mars – formation of North Polar Basin of Mars

- 9.3 billion years (4.5 Gya): Sun becomes a main sequence yellow star: formation of the Oort Cloud and Kuiper Belt from which a stream of comets like Halley's Comet and Hale-Bopp begins passing through the Solar System, sometimes colliding with planets and the Sun

- 9.396 billion years (4.404 Gya): Liquid water may have existed on the surface of the Earth, probably due to the greenhouse warming of high levels of methane and carbon dioxide present in the atmosphere.

- 9.4 billion years (4.4 Gya): Formation of Kepler 438 b, one of the most Earth-like planets, from a protoplanetary nebula surrounding its parent star

- 9.5 billion years (4.3 Gya): Massive meteorite impact creates South Pole Aitken Basin on the Moon – a huge chain of mountains located on the lunar southern limb, sometimes called "Leibnitz mountains", form

- 9.6 billion years (4.2 Gya): Tharsis Bulge widespread area of vulcanism, becomes active on Mars – based on the intensity of volcanic activity on Earth, Tharsis magmas may have produced a 1.5-bar Carbon dioxide atmosphere and a global layer of water 120 m deep increasing greenhouse gas effect in climate and adding to Martian water table. Age of the oldest samples from the Lunar Maria

- 9.7 billion years (4.1 Gya): Resonance in Jupiter and Saturn's orbits moves Neptune out into the Kuiper belt causing a disruption among asteroids and comets there. As a result, Late Heavy Bombardment batters the inner Solar System. Herschel Crater formed on Mimas (moon), a moon of Saturn. Meteorite impact creates the Hellas Planitia on Mars, the largest unambiguous structure on the planet. Anseris Mons an isolated massif (mountain) in the southern highlands of Mars, located at the northeastern edge of Hellas Planitia is uplifted in the wake of the meteorite impact
- 9.8 billion years (4 Gya): HD 209458 b, first planet detected through its transit, forms. Messier 85, lenticular galaxy, disrupted by galaxy interaction: complex outer structure of shells and ripples results. Andromeda and Triangulum galaxies experience close encounter – high levels of star formation in Andromeda while Triangulum's outer disc is distorted.

- 9.861 billion years (3.938 Gya): Major period of impacts on the Moon: Mare Imbrium forms.


- 9.9 billion years (3.9 Gya): Tolstoj (crater) forms on Mercury. Caloris Basin forms on Mercury leading to creation of "Weird Terraine" – seismic activity triggers volcanic activity globally on Mercury. Rembrandt (crater) formed on Mercury. Caloris Period begins on Mercury. Argyre Planitia forms from asteroid impact on Mars: surrounded by rugged massifs which form concentric and radial patterns around basin – several mountain ranges including Charitum and Nereidum Montes are uplifted in its wake.

- 9.95 billion years (3.85 Gya): Beginning of Late Imbrium Period on Moon. Earliest appearance of Procellarum KREEP Mg suite materials.

- 9.96 billion years (3.84 Gya): Formation of Orientale Basin from asteroid impact on Lunar surface – collision causes ripples in crust, resulting in three concentric circular features known as Montes Rook and Montes Cordillera.

- 10 billion years (3.8 Gya): In the wake of Late Heavy Bombardment impacts on the Moon, large molten mare depressions dominate lunar surface – major period of Lunar vulcanism begins (to 3 Gyr). Archean eon begins on the Earth.

- 10.2 billion years (3.6 Gya): Alba Mons forms on Mars, largest volcano in terms of area.

- 10.4 billion years (3.5 Gya): Earliest fossil traces of life on Earth (stromatolites).

- 10.6 billion years (3.2 Gya): Amazonian Period begins on Mars: Martian climate thins to its present density: groundwater stored in upper crust (megaregolith) begins to freeze, forming thick cryosphere overlying deeper zone of liquid water – dry ices composed of frozen carbon dioxide form Eratosthenian period begins on the Moon: main geologic force on the Moon becomes impact cratering.

- 10.8 billion years (3 Gya): Beethoven Basin forms on Mercury – unlike many basins of similar size on the Moon, Beethoven is not multi ringed and ejecta buries crater rim and is barely visible.

- 11.2 billion years (2.5 Gya): Proterozoic begins.

- 11.6 billion years (2.2 Gya): Last great tectonic period in Martian geologic history: Valles Marineris, largest canyon complex in the Solar System, forms – although some suggestions of thermokarst activity or even water erosion, it is suggested Valles Marineris is rift fault.

- 12.1 billion years (1.7 Gya): Sagittarius Dwarf Elliptical Galaxy captured into an orbit around Milky Way Galaxy
- 12.7 billion years (1.1 Gya): Copernican Period begins on Moon: defined by impact craters that possess bright optically immature ray systems
- 12.8 billion years (1 Gya): Kuiperian Era (1 Gyr – present) begins on Mercury: modern Mercury, desolate cold planet influenced by space erosion and solar wind extremes. Interactions between Andromeda and its companion galaxies Messier 32 and Messier 110. Galaxy collision with Messier 82 forms its spiral patterned disc: galaxy interactions between NGC 3077 and Messier 81
- 13 billion years (800 Mya): Copernicus (lunar crater) forms from impact on Lunar surface in the area of Oceanus Procellarum – has terrace inner wall and 30 km wide, sloping rampart that descends nearly a kilometer to the surrounding mare
- 13.175 billion years (625 Mya): formation of Hyades star cluster: consists of a roughly spherical group of hundreds of stars sharing same age, place of origin, chemical content and motion through space
- 13.2 billion years (600 Mya): Collision of spiral galaxies leads to creation of Antenna Galaxies. Whirlpool Galaxy collides with NGC 5195 forming present connected galaxy system. HD 189733 b forms around parent star HD 189733: first planet to reveal climate, organic constituencies, even colour (blue) of its atmosphere
- 13.6–13.5 billion years (300-200 Mya): Sirius, the brightest star in the Earth's sky, forms.
- 13.795 billion years (100 Mya): Formation of Pleiades Star Cluster
- 13.790 billion years (20 Mya): Possible formation of Orion Nebula
- 13.788 billion years (12 Mya): Antares forms.
- 13.792 billion years (7.6 Mya): Betelgeuse forms.
- 13.795 billion years (4.4 Mya): Fomalhaut b, first directly imaged exoplanet, forms
- 13.8 billion years (Without uncertainties): Present day.

Timeline of the Middle Ages

5th and 6th centuries

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 400</td>
<td>Highland Maya fall to the lowland city of Teotihuacan</td>
<td>Begins the decline of Maya culture and language in some parts of the highlands.</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
<td>Details</td>
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<tr>
<td>405</td>
<td>St. Jerome finished the Vulgate.</td>
<td>The Christian Gospel is translated into Latin.</td>
<td></td>
</tr>
<tr>
<td>410</td>
<td>August 24</td>
<td>Rome is sacked by Alaric, King of the Visigoths.</td>
<td>Decisive event in the decline of the Western Roman Empire.</td>
</tr>
<tr>
<td>431</td>
<td>June 22 – July 31</td>
<td>Council of Ephesus</td>
<td>Confirmed the original Nicene Creed, and condemned the teachings of Nestorius, Patriarch of Constantinople, that led to his exile and separation with the Church of the East.</td>
</tr>
<tr>
<td>455</td>
<td>June 2</td>
<td>Rome is sacked by Genseric, King of the Vandals.</td>
<td>Another decisive event in the Fall of Rome and held by some historians to mark the &quot;end of the Roman Empire&quot;.</td>
</tr>
<tr>
<td>476</td>
<td>September 4</td>
<td>Odoacer deposes the Roman Emperor Romulus Augustulus</td>
<td>Considered by some historians to be the starting point of the Middle Ages.</td>
</tr>
<tr>
<td>480</td>
<td>April 25</td>
<td>Death of Julius Nepos, last Roman Emperor to be recognized as such by the Roman Senate and the Eastern court</td>
<td>Considered by some historians to be the starting point of the Middle Ages.</td>
</tr>
<tr>
<td>c. 500</td>
<td>Tikal becomes the first great Maya city</td>
<td>Significant cultural exchange between the Maya of Tikal and the citizens of Teotihuacan.</td>
<td></td>
</tr>
<tr>
<td>c. 500</td>
<td>Battle of Mons Badonicus.</td>
<td>The West Saxon advance is halted by Britons in England. Chiefly known today for the supposed involvement of King Arthur but because of the limited number of sources, there is no certainty about the date, location, or details of the fighting.</td>
<td></td>
</tr>
<tr>
<td>507</td>
<td>Spring</td>
<td>The Franks under Clovis defeat the Visigoths in the Battle of Vouillé.</td>
<td>The Visigoths retreated into Spain.</td>
</tr>
<tr>
<td>c. 524</td>
<td>Boethius writes his <em>Consolation of Philosophy</em></td>
<td>It has been described as the single most important and influential work in the West on Medieval and early Renaissance Christianity.</td>
<td></td>
</tr>
<tr>
<td>525</td>
<td>Dionysius Exiguus publishes the Dionysius Exiguus' Easter table.</td>
<td>This initiated the Anno Domini era, used for the Gregorian and Julian calendars.</td>
<td></td>
</tr>
<tr>
<td>527</td>
<td>August 1</td>
<td>Justinian I becomes Eastern Roman Emperor.</td>
<td>Justinian is best remembered for his Code of Civil Law (529), and expansion of imperial territory retaking Rome from the Ostrogoths.</td>
</tr>
<tr>
<td>529–534</td>
<td>Justinian I publishes the Code of Civil Law.</td>
<td>This compiled centuries of legal writings and imperial pronouncements into three parts of one body of law.</td>
<td></td>
</tr>
<tr>
<td>529</td>
<td>Benedict of Nursia founds monastery at Monte Cassino.</td>
<td>The first of twelve monasteries founded by Saint Benedict, beginning the Order of Saint Benedict.</td>
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</tr>
<tr>
<td>Year(s)</td>
<td>Event</td>
<td>Description</td>
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<tr>
<td>532</td>
<td>January 1 Nika riots in Constantinople.</td>
<td>Nearly half the city being burned or destroyed and tens of thousands of people killed.</td>
<td></td>
</tr>
<tr>
<td>535–554</td>
<td>Gothic War in Italy as a part of Justinian's Reconquest.</td>
<td>Byzantines retook Italy but crippled the Byzantine economy and left Italy unable to cope against the oncoming Lombards.</td>
<td></td>
</tr>
<tr>
<td>563</td>
<td>Saint Columba founds mission in Iona.</td>
<td>Constructed an abbey which helped convert the Picts to Christianity until it was destroyed and raided by the Vikings in 794.</td>
<td></td>
</tr>
<tr>
<td>568</td>
<td>The Kingdom of the Lombards is founded in Italy.</td>
<td>Survived in Italy until the invasion of the Franks in 774 under Charlemagne.</td>
<td></td>
</tr>
<tr>
<td>c. 570</td>
<td>Muhammad is born.</td>
<td>Professed receiving revelations from a god, which were recorded in the Quran, the basis of Islamic theology, in which he is regarded as the last of the sent prophets.</td>
<td></td>
</tr>
<tr>
<td>577</td>
<td>The West Saxons continue their advance at the Battle of Deorham.</td>
<td>Led to the permanent separation of Cornwall, England from Wales.</td>
<td></td>
</tr>
<tr>
<td>581–618</td>
<td>March 4 – May 23 Sui dynasty in China.</td>
<td>China unified once again during this period for the first time in almost 400 years.</td>
<td></td>
</tr>
<tr>
<td>590</td>
<td>September 3 Gregory the Great becomes Pope.</td>
<td>The missionary work reached new levels during his pontificate, revolutionized the way of worship for the Catholic Church (Gregorian chant), liturgy, etc., and was soon canonized after his death.</td>
<td></td>
</tr>
<tr>
<td>598–668</td>
<td>Massive Chinese (Sui and Tang) invasions against Korean Goguryeo.</td>
<td>Contributed to the fall of the Sui dynasty, and Goguryeo fell under the forces of the Tang and Silla.</td>
<td></td>
</tr>
<tr>
<td>c. 600</td>
<td>Deliberate fires set for unknown reasons destroy major buildings in Teotihuacan.</td>
<td>Destroys the Teotihuacan civilization and empire. Tikal is now the largest city-state in Mesoamerica.</td>
<td></td>
</tr>
</tbody>
</table>

7th century
<table>
<thead>
<tr>
<th>Year</th>
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</tr>
</thead>
<tbody>
<tr>
<td>602–</td>
<td>± 629</td>
<td>Last great Roman–Persian War.</td>
<td>Long conflict leaves both empires exhausted and unable to cope with the newly united Arab armies under Islam in the 630s.</td>
</tr>
<tr>
<td>604–</td>
<td>± 609</td>
<td>Grand Canal in China is fully completed</td>
<td>Its main role throughout its history was the transport of grain to the capital.</td>
</tr>
<tr>
<td>618–</td>
<td>June 18 –</td>
<td>Tang dynasty in China.</td>
<td>The essential administrative system of this dynasty lasts for 286 years.</td>
</tr>
<tr>
<td>618–</td>
<td>June 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>622</td>
<td>9 September – 23 September</td>
<td>Muhammad migrates from Mecca to Medina.</td>
<td>Event will have designated first year of the Islamic calendar, as Anno Hegirae.</td>
</tr>
<tr>
<td>626</td>
<td>June 8</td>
<td>Joint Persian–Avar–Slav Siege of Constantinople</td>
<td>Constantinople saved, Avar power broken and Persians henceforth on the defensive.</td>
</tr>
<tr>
<td>627</td>
<td>December 12</td>
<td>Battle of Nineveh.</td>
<td>The Byzantines, under Heraclius, crush the Persians.</td>
</tr>
<tr>
<td>632</td>
<td>June 8</td>
<td>Death of Muhammad</td>
<td>By this point, all of Arabia is Muslim.</td>
</tr>
<tr>
<td>632–</td>
<td>± 668</td>
<td>Establishment and expansion of Old Great Bulgaria.</td>
<td>The demise of Old Great Bulgaria lead to the founding of the First Bulgarian Empire and Volga Bulgaria by the sons of Kubrat.</td>
</tr>
<tr>
<td>632</td>
<td>June 8</td>
<td>Accession of Abu Bakr as first Caliph.</td>
<td>Though the period of his caliphate was not long, it included successful invasions of the two most powerful empires of the time.</td>
</tr>
<tr>
<td>638</td>
<td></td>
<td>Jerusalem captured by the Arab army, mostly Muslims, but with contingents of Syrian Christians.</td>
<td></td>
</tr>
<tr>
<td>641</td>
<td></td>
<td>Battle of Nahavand. Muslims conquer Persia.</td>
<td></td>
</tr>
<tr>
<td>643</td>
<td></td>
<td>Arab Army led by Amr ibn al-As takes Alexandria.</td>
<td></td>
</tr>
<tr>
<td>645</td>
<td></td>
<td>In Japan, the Soga clan falls.</td>
<td>This initiates a period of imitation of Chinese culture, The Nara period begins a year later.</td>
</tr>
<tr>
<td>650</td>
<td></td>
<td>Slav occupation of Balkans complete.</td>
<td></td>
</tr>
<tr>
<td>c. 650</td>
<td></td>
<td>The city-state Xochicalco is founded by the Olmeca–Xicallanca.</td>
<td>Becomes an important cultural and commercial center.</td>
</tr>
</tbody>
</table>
663 | Synod of Whitby. | Roman Christianity triumphs over Celtic Christianity in England.
---|---|---
668 | End of the Three Kingdoms period in Korea. | Established a Unified Silla which led to the North–South States Period 30 years later.
674–678 | First Arab siege of Constantinople. | First time Islamic armies defeated, forestalling Islamic conquest of Europe.
681 | Establishment of the Bulgarian Empire. | A country with great influence in the European history in the Middle Ages.
685 | Battle of Dun Nechtain. | Picts defeat Northumbrians, whose dominance ends.
687 | Battle of Tertry | Established Pepin of Herstal as mayor over the entire realms of Neustria and Austrasia, which further dwindled Merovingian power.
698 | Arab army takes Carthage. | End of Byzantine rule in North Africa.
698 | North–South States Period begins in Korea. | Silla and Balhae coexisted in the south and north of the peninsula, respectively, until 926.

8th century

<table>
<thead>
<tr>
<th>Year</th>
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</tr>
</thead>
<tbody>
<tr>
<td>711</td>
<td></td>
<td>Umayyad conquest of Hispania under Tarik.</td>
<td>Will begin a period of Muslim rule within the Al-Andalus (with various portions of Iberian peninsula) until nearly the end of the Fifteenth Century.</td>
</tr>
<tr>
<td>718</td>
<td></td>
<td>Second Arab attack on Constantinople, ending in failure.</td>
<td>The combined Byzantine–Bulgarian forces stop the Arab threat in Southeastern Europe.</td>
</tr>
<tr>
<td>726</td>
<td></td>
<td>Iconoclast movement begun in the Byzantine Empire under Leo III. This was opposed by Pope Gregory II, and an important difference between the Roman and Byzantine churches.</td>
<td></td>
</tr>
<tr>
<td>732</td>
<td>October</td>
<td>Battle of Tours. Charles Martel halts Muslim advance.</td>
<td>Significant moment that led to the forming of the Carolingian Empire for the Franks, and halted the advancement of the Moors in southwestern Europe.</td>
</tr>
<tr>
<td>735</td>
<td>26 May</td>
<td>Death of Bede.</td>
<td>Bede was later regarded as &quot;the father of English...&quot;</td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
<td>Significance</td>
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<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>750</td>
<td>25 January</td>
<td>Beginning of Abbasid Caliphate.</td>
<td>Would become the longest lasting caliphate, until 1519 when conquered and annexed into the Ottoman Empire.</td>
</tr>
<tr>
<td>751</td>
<td></td>
<td>Pepin the Short founds the Carolingian dynasty.</td>
<td></td>
</tr>
<tr>
<td>754</td>
<td></td>
<td>Pepin promises the Pope central Italy.</td>
<td>This is arguably the beginning of the temporal power of the Papacy.</td>
</tr>
<tr>
<td>768</td>
<td></td>
<td>Beginning of Charlemagne's reign.</td>
<td></td>
</tr>
<tr>
<td>778</td>
<td>15 August</td>
<td>Battle of Roncevaux Pass.</td>
<td></td>
</tr>
<tr>
<td>786</td>
<td>14 September</td>
<td>Accession of Harun al-Rashid to the Caliphate in Baghdad.</td>
<td></td>
</tr>
<tr>
<td>793</td>
<td></td>
<td>Sack of Lindisfarne. Viking attacks on Britain begin.</td>
<td>Generally considered the beginning of the Viking Age that would span over two centuries, and reach as far south as Hispania and as far east as the Byzantine Empire, and present day Russia.</td>
</tr>
<tr>
<td>794</td>
<td></td>
<td>Heian period in Japan.</td>
<td>Considered to be the last classical period of History of Japan. Chinese influence was at its strongest during this era in Japan.</td>
</tr>
<tr>
<td>795</td>
<td>29 July</td>
<td>Death of Offa.</td>
<td>Marks the end of Mercian dominance in England.</td>
</tr>
<tr>
<td>800</td>
<td>25 December</td>
<td>Charlemagne is crowned Holy Roman Emperor.</td>
<td>With his crowning, Charlemagne's kingdom is officially recognized by the Papacy as the largest in Europe since the fall of the Roman Empire.</td>
</tr>
<tr>
<td>800</td>
<td></td>
<td>Gunpowder is invented in China</td>
<td>(somewhere around 9th century)</td>
</tr>
</tbody>
</table>

**9th century**

<table>
<thead>
<tr>
<th>Year</th>
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</tr>
</thead>
<tbody>
<tr>
<td>814</td>
<td>28 January</td>
<td>Death of Charlemagne.</td>
<td>Would be a factor towards the splitting of his empire almost 30 years later.</td>
</tr>
<tr>
<td>820</td>
<td></td>
<td>Algebrae et Alumcabola Algorithm</td>
<td>Muhammad ibn Musa- al-Khwarizmi</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
<td>Additional Information</td>
<td></td>
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</tr>
<tr>
<td>827</td>
<td>Muslims invade Sicily.</td>
<td>First encounter of attempts to conquer Byzantine Sicily, until the last Byzantine outpost was conquered in 965.</td>
<td></td>
</tr>
<tr>
<td>840</td>
<td>Muslims capture Bari and much of southern Italy.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>843</td>
<td>Division of Charlemagne's Empire between his grandsons with the Treaty of Verdun.</td>
<td>Sets the stage for the founding of the Holy Roman Empire and France as separate states.</td>
<td></td>
</tr>
<tr>
<td>843</td>
<td>Kenneth McAlpin becomes king of the Picts and Scots, creating the Kingdom of Alba.</td>
<td></td>
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</tr>
<tr>
<td>862</td>
<td>Viking state in Russia founded under Rurik, first at Novgorod, then Kiev.</td>
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</tr>
<tr>
<td>864</td>
<td>Christianization of Bulgaria.</td>
<td></td>
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</tr>
<tr>
<td>866</td>
<td>Fujiwara period in Japan.</td>
<td>Would become the most powerful clan during the Heian period in Japan for around three centuries.</td>
<td></td>
</tr>
<tr>
<td>866</td>
<td>Viking Great Army arrives in England.</td>
<td>Northumbria, East Anglia, and Mercia were overwhelmed.</td>
<td></td>
</tr>
<tr>
<td>868</td>
<td>Earliest known printed book in China with a date.</td>
<td></td>
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</tr>
<tr>
<td>871</td>
<td>Alfred the Great assumes the throne, the first king of a united England.</td>
<td>He defended England from Viking invaders, formed new laws and fostered a rebirth of religious and scholarly activities.</td>
<td></td>
</tr>
<tr>
<td>c. 872</td>
<td>Harold Fairhair becomes King of Norway.</td>
<td></td>
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<tr>
<td>874</td>
<td>Iceland is settled by Norsemen.</td>
<td></td>
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<tr>
<td>882</td>
<td>Kievan Rus' is established.</td>
<td>Would be sustained until the Mongol invasion of Rus' over four and a half centuries, despite peaking during the middle 11th century during the reign of Yaroslav the Wise.</td>
<td></td>
</tr>
<tr>
<td>885</td>
<td>Arrival of the disciples of Saints Cyril and Methodius in Bulgaria</td>
<td>Creation of the Cyrillic script; in the following decades the country became the cultural and spiritual centre of the whole Eastern Orthodox part of the Slavic World.</td>
<td></td>
</tr>
<tr>
<td>885–886</td>
<td>Vikings attack Paris.</td>
<td></td>
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<tr>
<td>893</td>
<td>Emperor Simeon I becomes ruler of the First Bulgarian Empire</td>
<td>Golden age of the First Bulgarian Empire (896–927). The Cyrillic alphabet was developed in the Preslav</td>
<td></td>
</tr>
</tbody>
</table>
the Balkans. Literary School and Ohrid Literary School.

896 Arpad and the Magyars are present in Pannonia.

899 27 October Death of Alfred the Great.

c. 900 Lowland Maya cities in the south collapse. Signifies the end of the Classic Period of Maya history. The Maya in northern Yucatán continue to thrive.

10th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>910</td>
<td></td>
<td>King Edward the Elder of England, son of King Alfred, defeats the Northumbrian Vikings at the Battle of Tettenhall; they never raid south of the River Humber again.</td>
<td></td>
</tr>
<tr>
<td>910</td>
<td></td>
<td>Cluny Abbey is founded by William I, Count of Auvergne.</td>
<td>Cluny goes on to become the acknowledged leader of Western Monasticism. Cluniac Reforms initiated with the abbey's founding.</td>
</tr>
<tr>
<td>911</td>
<td></td>
<td>The Viking Rollo and his tribe settle in what is now Normandy by the terms of the Treaty of Saint-Clair-sur-Epte, founding the Duchy of Normandy.</td>
<td></td>
</tr>
<tr>
<td>913</td>
<td></td>
<td>Sri Kesari Warmadewa reigned in Walidwipa (Bali)</td>
<td></td>
</tr>
<tr>
<td>917</td>
<td></td>
<td>Battle of Anchialus. Simeon I the Great defeats the Byzantines.</td>
<td>Recognition of the Imperial Title of the Bulgarian rulers.</td>
</tr>
<tr>
<td>919</td>
<td></td>
<td>Henry the Fowler, Duke of Saxony elected German King. First king of the Ottonian Dynasty.</td>
<td>Henry I considered the founder and first king of the medieval German state.</td>
</tr>
<tr>
<td>925</td>
<td></td>
<td>The first King of Croatia (rex Croatorum), Tomislav (910–928) of the Trpimirović dynasty was crowned.</td>
<td>Tomislav united Croats of Dalmatia and Pannonia into a single Kingdom, and created a sizeable state.</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
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<tr>
<td>927</td>
<td>King Aethelstan the Glorious unites the heptarchy of The Anglo-Saxon nations of Wessex, Sussex, Essex, Kent, East Anglia, Mercia and Northumbria founding the Kingdom of England.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>927</td>
<td>According to Theophanes Continuatus (The Continuer of Theophanes’s Chronicle) – Tomislav of Croatia defeated Bulgarian army of Tsar Simeon I under Duke Alogobotur, in battle of the Bosnian Highlands.</td>
<td></td>
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<tr>
<td></td>
<td>Bulgarian expansion to the west was stopped.</td>
<td></td>
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<tr>
<td>927</td>
<td>Death of Simeon I the Great. Recognition of the Bulgarian Patriarchate, the first independent National Church in Europe.</td>
<td></td>
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<tr>
<td>929</td>
<td>Abd-ar-Rahman III of the Umayyad dynasty in al-Andalus (part of the Iberian peninsula) takes the title of Caliph or ruler of the Islamic world.</td>
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<tr>
<td></td>
<td>Beginning of the Caliphate of Córdoba (929–1031).</td>
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<tr>
<td>936</td>
<td>Wang Geon unified Later Three Kingdoms of Korea.</td>
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<tr>
<td>938</td>
<td>Ngo Quyen won the battle of Bach Dang against Chinese Southern Han army.</td>
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<tr>
<td></td>
<td>This event marked the independence of Vietnam after 1000 years under Chinese colony.</td>
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<tr>
<td>955</td>
<td>Battle of Lechfeld. Otto the Great, son of Henry the Fowler, defeats the Magyars.</td>
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<tr>
<td></td>
<td>This is the defining event that prevents the Hungarians from entering Central Europe.</td>
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<tr>
<td>c.960</td>
<td>Mieszko I becomes duke of Polans.</td>
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<tr>
<td></td>
<td>First historical ruler of Poland and de facto founder of the Polish State.</td>
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<tr>
<td>960</td>
<td>Song Dynasty begins after Emperor of Taizu usurps the throne from the Later Zhou, last of the Five Dynasties.</td>
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<td></td>
<td>A 319-year period of Song rule (Northern &amp; Southern combined) goes underway.</td>
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<tr>
<td>962</td>
<td>Otto the Great crowned the Holy Roman Emperor.</td>
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<td></td>
<td>First to be crowned Holy Roman Emperor in nearly 40 years.</td>
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<tr>
<td>963–964</td>
<td>Otto deposes Pope John XII who is replaced with Pope Leo VIII.</td>
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<tr>
<td></td>
<td>Citizens of Rome promise not to elect another Pope without Imperial approval.</td>
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<tr>
<td>965–967</td>
<td>Mieszko I of Poland and his court embrace Christianity, which becomes national religion.</td>
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<tr>
<td>969</td>
<td>John I Tzimiskes and Nikephoros II are executed.</td>
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<td></td>
<td>Sultane of Rums are proclaimed.</td>
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<tr>
<td>976</td>
<td>Death of John I Tzimiskes; Basil II (his co-emperor) takes sole power.</td>
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<tr>
<td></td>
<td>Under Basil II zenith of the power of Eastern Empire after Justinian.</td>
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<tr>
<td>978</td>
<td>Al-Mansur Ibn Abi Aamir becomes de facto ruler of</td>
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<tr>
<td></td>
<td>Peak of power of Moorish Iberia under</td>
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<tr>
<td>Year</td>
<td>Event</td>
<td>Significance</td>
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<tr>
<td>981</td>
<td>Basil II (called &quot;Bulgar Slayer&quot;) begins final conquest of Bulgaria by Eastern Empire.</td>
<td>Conquest finished by 1018.</td>
<td></td>
</tr>
<tr>
<td>985</td>
<td>Eric the Red, exiled from Iceland, begins Scandinavian colonization of Greenland.</td>
<td></td>
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</tr>
<tr>
<td>988</td>
<td>Volodymyr I of Kiev embraces Christianity, which becomes national religion.</td>
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</tr>
<tr>
<td>989</td>
<td>Peace and Truce of God formed.</td>
<td>The first movement of the Catholic Church using spiritual means to limit private war, and the first movement in medieval Europe to control society through non-violent means.</td>
<td></td>
</tr>
</tbody>
</table>

**11th century**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 1001</td>
<td>Leif Erikson is to settle during the winter in present-day Canada at L'Anse aux Meadows.</td>
<td>Ericson is to be the first European to settle in the Americas during the Norse exploration of the Americas.</td>
<td></td>
</tr>
<tr>
<td>1016</td>
<td>Canute the Great becomes King of England after the death of Edmund Ironside, with whom he shared the English throne.</td>
<td>Danes become kings of England for the next 26 years before the last rise of the Anglo-Saxons before the Norman Conquest.</td>
<td></td>
</tr>
<tr>
<td>1018</td>
<td>The Byzantines under Basil II conquer Bulgaria after a bitter 50-years struggle.</td>
<td>Concludes the Byzantine conquest of Bulgaria.</td>
<td></td>
</tr>
<tr>
<td>1021</td>
<td><em>The Tale of Genji</em>, written by Murasaki Shikibu, is completed sometime before this date.</td>
<td>It is sometimes called the world's first novel, the first modern novel, the first psychological novel or the first novel still to be considered a classic.</td>
<td></td>
</tr>
<tr>
<td>1025</td>
<td>The Canon of Medicine</td>
<td>Persian Avicenna set standard medical textbook through 18th century in Europe</td>
<td></td>
</tr>
<tr>
<td>1037</td>
<td>The Great Seljuk Empire is founded by Tughril Beg.</td>
<td>Would be a major force during the first two Crusades, and an antagonist to the Byzantine Empire over the next century.</td>
<td></td>
</tr>
<tr>
<td>1049</td>
<td>Pope Leo IX ascends to the papal throne.</td>
<td>Leo IX was the pope that</td>
<td></td>
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<tr>
<td>Year</td>
<td>Event</td>
<td>Description</td>
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<td>-----------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>1050</td>
<td>The astrolabe, an ancient tool of navigation, is first used in Europe.</td>
<td>Early tool of marine navigators, astrologers, astronomers.</td>
<td></td>
</tr>
<tr>
<td>1050</td>
<td>Westminster Abbey</td>
<td>Edward the Confessor</td>
<td></td>
</tr>
<tr>
<td>1054</td>
<td>The East-West Schism which divided the church into Western Catholicism and Eastern Orthodoxy.</td>
<td>Tensions will vary between the Catholic and Orthodox churches throughout the Middle Ages.</td>
<td></td>
</tr>
<tr>
<td>1066</td>
<td>William the Conqueror, Duke of Normandy, invades England and becomes King after the Battle of Hastings.</td>
<td>End of Anglo-Saxon rule in England and start of Norman lineage.</td>
<td></td>
</tr>
<tr>
<td>1067</td>
<td>Pope Gregory VII elevated to the papal throne.</td>
<td>This begins a period of church reform.</td>
<td></td>
</tr>
<tr>
<td>1071</td>
<td>The Seljuks under Alp Arslan defeat the Byzantine army at Manzikert.</td>
<td>Beginning of the end of Byzantine rule in Asia Minor.</td>
<td></td>
</tr>
<tr>
<td>1071</td>
<td>The Normans capture Bari, the last Byzantine possession in southern Italy.</td>
<td></td>
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</tr>
<tr>
<td>1075</td>
<td>Dictatus Papae in which Pope Gregory VII defines the powers of the pope.</td>
<td>Peak of the Gregorian Reform, and an immense factor in the Investiture Controversy.</td>
<td></td>
</tr>
<tr>
<td>1077</td>
<td>Holy Roman Emperor Henry IV walks to Canossa where he stands barefoot in the snow to beg forgiveness of the Pope for his offences, and admitting defeat in the Investiture Controversy.</td>
<td>This helps establish Papal rule over European heads of state for another 450 years.</td>
<td></td>
</tr>
<tr>
<td>1077</td>
<td>The Construction of the Tower of London begins.</td>
<td>The tower of London was the ultimate keep of the British Empire.</td>
<td></td>
</tr>
<tr>
<td>1086</td>
<td>The compilation of the Domesday Book, a great land and property survey commissioned by William the Conqueror to assess his new possessions.</td>
<td>This is the first such undertaking since Roman times.</td>
<td></td>
</tr>
<tr>
<td>1088</td>
<td>University of Bologna is formed.</td>
<td>It is the oldest university in Europe.</td>
<td></td>
</tr>
<tr>
<td>1095</td>
<td>Pope Urban issues the Crusades to capture the Holy Land, and to repel the Seljuk Turks from the Byzantine Empire from Alexios I Komnenos.</td>
<td>This would be the first of 9 Major Crusades, and a number of other crusades that would spread into the late 13th century.</td>
<td></td>
</tr>
<tr>
<td>1098</td>
<td>The Cistercian Order is founded.</td>
<td>Was a return to the original observance of the Rule of St. Benedict.</td>
<td></td>
</tr>
<tr>
<td>1099</td>
<td>First Crusade. Jerusalem is re-taken from the</td>
<td>This would lead to the beginning of</td>
<td></td>
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</tbody>
</table>
Muslims on the urging of Pope Urban II. the Kingdom of Jerusalem, which would last for nearly two centuries; within the era of the Crusades to the Holy Land.

12th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1102</td>
<td></td>
<td>Kingdom of Croatia and Kingdom of Hungary formed a personal union of two kingdoms united under the Hungarian king. The act of union was dealt with Pacta conventa, by which institutions of separate Croatian statehood were maintained through the Sabor (an assembly of Croatian nobles) and the ban (viceroy). In addition, the Croatian nobles retained their lands and titles.</td>
<td>Medieval Hungary and Croatia were (in terms of public international law) allied by means of personal union until 1526. Although, Hungarian-Croatian state existed until the beginning of the 20th century and the Treaty of Trianon.</td>
</tr>
<tr>
<td>1102</td>
<td></td>
<td>Synods of Westminster</td>
<td>End of simony, clerical marriages, slavery under Anselm of Canterbury</td>
</tr>
<tr>
<td>1106</td>
<td>28 September</td>
<td>Henry I of England defeats his older brother Robert Curthose, duke of Normandy, at the Battle of Tinchebrai, and imprisons him in Devizes castle; Edgar Atheling and William Clito are also taken prisoner.</td>
<td>This victory made a later struggle between England and the rising Capetian power in France inevitable.</td>
</tr>
<tr>
<td>1107</td>
<td></td>
<td>Through the Compromise of 1107, suggested by Adela, the sister of King Henry, the Investiture Struggle in England is ended.</td>
<td>This compromise removed one of the points of friction between the English monarchy and the Catholic Church.</td>
</tr>
<tr>
<td>1109</td>
<td></td>
<td>In the Battle of Naklo, Boleslaus III Wrymouth defeats the Pomeranians.</td>
<td>Polish access to the sea is re-established.</td>
</tr>
<tr>
<td>1109</td>
<td>24 August</td>
<td>In the Battle of Hundsfeld, Boleslaus III Wrymouth defeats Emperor Henry V.</td>
<td>German expansion to the centre of Europe is stopped.</td>
</tr>
<tr>
<td>1116</td>
<td></td>
<td>The Byzantine army defeats the Turks at Philomelion.</td>
<td>The Turks abandon the entire coastal area of Anatolia and all of western Anatolia</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
<td>Additional Information</td>
<td></td>
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<tr>
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<td></td>
</tr>
<tr>
<td>1117</td>
<td>The University of Oxford is founded.</td>
<td>It is the oldest university in the United Kingdom.</td>
<td></td>
</tr>
<tr>
<td>1118</td>
<td>The Knights Templar are founded to protect Jerusalem and European pilgrims on their journey to the city.</td>
<td>Becomes the most recognizable, and impactful military orders during the Crusades.</td>
<td></td>
</tr>
<tr>
<td>1121</td>
<td>25 December</td>
<td>St. Norbert and 29 companions make their solemn vows marking the beginning of the Premonstratensian Order. This order played a significant role in evangelizing the Slavs, the Wends, to the east of the Holy Roman Empire.</td>
<td></td>
</tr>
<tr>
<td>1122</td>
<td>23 September</td>
<td>The Concordat of Worms was drawn up between Emperor Henry V and Pope Calixtus II. This concordat ended the investiture struggle, but bitter rivalry between emperor and pope remained.</td>
<td></td>
</tr>
<tr>
<td>1123</td>
<td>18 March - 27 March</td>
<td>The First Lateran Council followed and confirmed the Concordat of Worms.</td>
<td></td>
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<tr>
<td>1125</td>
<td>School of Glossators</td>
<td>Irnerius</td>
<td></td>
</tr>
<tr>
<td>1125</td>
<td>Lothair of Supplinburg, duke of Saxony, is elected Holy Roman Emperor instead of the nearest heir, Frederick of Swabia.</td>
<td>This election marks the beginning of the great struggle between the Guelfs and the Ghibellines.</td>
<td></td>
</tr>
<tr>
<td>1125–1127</td>
<td>Jingkang Incident</td>
<td>The Jurchen soldiers sack Kaifeng, bringing an end to the Northern Song Dynasty in China; the Song moves further south and makes Lin’an their new capital.</td>
<td></td>
</tr>
<tr>
<td>1130</td>
<td>25 December</td>
<td>Roger II is crowned King of Sicily, a Royal title given him by the Antipope Anacletus II. This coronation marks the beginning of the Kingdom of Sicily and its Mediterranean empire under the Norman kings, which was able to take on the Holy Roman Empire, the Papacy, and the Byzantine Empire.</td>
<td></td>
</tr>
<tr>
<td>1130</td>
<td>Sic et Non</td>
<td>Peter Abelard</td>
<td></td>
</tr>
<tr>
<td>1135</td>
<td>The Anarchy begins in England.</td>
<td>This will mark a 19-year period of Government strife and Civil War between the supporters of Stephen and Matilda, and end with the crowning of Matilda's son, Henry II, and beginning the Plantagenet dynasty.</td>
<td></td>
</tr>
<tr>
<td>1139</td>
<td>April</td>
<td>The Second Lateran Council declared clerical marriages invalid, regulated clerical dress, and Enforces the major reforms that Gregory VII began to heavily campaign for several</td>
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<tr>
<td>Year</td>
<td>Event</td>
<td>Details</td>
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<tr>
<td>1140</td>
<td>Decretum</td>
<td>punished attacks on clerics by excommunication. decades earlier.</td>
<td></td>
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<tr>
<td>1144</td>
<td>Rebuild of Basilica of Saint Denis</td>
<td>Gratian</td>
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</tr>
<tr>
<td>1147–1149</td>
<td>The Second Crusade was in retaliation for the fall of Edessa, one of the first Crusader States founded in the First Crusade. It was an overall failure.</td>
<td>This was the first Crusade to have been led by European kings.</td>
<td></td>
</tr>
<tr>
<td>1150</td>
<td>Ramon Berenguer IV, Count of Barcelona, married Queen Petronilla of Aragon. They had been betrothed in 1137.</td>
<td>This marriage gave the Kingdom of Aragon access to the Mediterranean Sea, creating a powerful kingdom which expanded to control many of the Mediterranean lands.</td>
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<tr>
<td>1150</td>
<td>Founding of the University of Paris</td>
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<tr>
<td>1152</td>
<td>The Synod of Kells-Mellifont established the present diocesan system of Ireland (with later modifications) and recognized the primacy of Armagh.</td>
<td>This synod marks the inclusion of the Irish Church into mainstream European Catholicism.</td>
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<tr>
<td>1154</td>
<td>Common Law</td>
<td>Henry II</td>
<td></td>
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<tr>
<td>1158</td>
<td>The Hanseatic League is founded.</td>
<td>This marks a new period of trade and economic development for northern and central Europe.</td>
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<tr>
<td>1163</td>
<td>The first cornerstone is laid for the construction of Notre Dame de Paris.</td>
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<tr>
<td>1166</td>
<td>Stefan Nemanja united Serbian territories, establishing the Medieval Serbian state.</td>
<td>This marks the rise of Serbia which will dominate the Balkans for the next three hundred years. Allies of Serbia at this moment become the Hungarian Kingdom and the Republic of Venice.</td>
<td></td>
</tr>
<tr>
<td>1171</td>
<td>King Henry II of England lands in Ireland to assert his supremacy and the Synod of Cashel acknowledges his sovereignty.</td>
<td>With his landing, Henry begins the English claim to and occupation of Ireland which would last some seven and a half centuries.</td>
<td></td>
</tr>
<tr>
<td>1174</td>
<td>7/12</td>
<td>King William I of Scotland, captured in the Battle of Alnwick by the English, accepts the feudal lordship of the English crown and does ceremonial allegiance at York. This is the beginning of the gradual acquisition of Scotland by the English.</td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>Hōnen Shōnin (Genkū) founds the Jōdo</td>
<td>This event marks the beginning of the</td>
<td></td>
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<tr>
<td>Date</td>
<td>Event</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>1176</td>
<td>5/29 At the Battle of Legnano, the cavalry of Frederick Barbarossa is defeated by the infantry of the Lombard League. This is the first major defeat of cavalry by infantry, signaling the new role of the bourgeoisie.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1175</td>
<td>Latin-translation Gerard of Cremona</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1179</td>
<td>church schools Third Council of the Lateran</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1179</td>
<td>March The Third Lateran Council limits papal electees to the cardinals alone, condemns simony, and forbids the promotion of anyone to the episcopate before the age of thirty.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1183</td>
<td>The final Peace of Constance between Frederick Barbarossa, the pope, and the Lombard towns is signed. The various articles of the treaty destroyed the unity of the Empire and Germany and Italy underwent separate developments.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1183</td>
<td>The Taira clan are driven out of Kyōto by Minamoto Yoshinaka. The two-year conflict which follows ends at the Battle of Dan no Ura (1185).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1184</td>
<td>November Pope Lucius III issues the papal bull <em>Ad Abolendam</em>. This bull set up the organization of the medieval inquisitions.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1185</td>
<td>Windmills are first recorded.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1185</td>
<td>Uprising of Asen and Peter. The reestablishment of the Bulgarian Empire.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1185</td>
<td>At the Battle of Dan no Ura, Minamoto Yoshitsune annihilates the Taira clan. The elimination of the Taira leaves the Minamoto the virtual rulers of Japan and marks the beginning of the first period of feudal rule known as the Kamakura Period.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1186</td>
<td>1/27 The future emperor Henry VI marries Constance of Sicily, heiress to the Sicilian throne. This marriage shifts the focus of the Guelphs/Ghibelline struggle to Sicily and marks the ruin of the House of Hohenstaufen.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1187</td>
<td>Saladin recaptures Jerusalem. Would lead to the Third Crusade.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1188</td>
<td>Tractatus of Glanvill Oxford University</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1189</td>
<td>July 6 Richard I ascends the throne of England. His heavy taxation to finance his European ventures created an antipathy of barons and people toward the crown, but his being absent enabled the English to advance in their political development.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1189</td>
<td>The Third Crusade follows upon Saladin's Despite managing to win several major</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
<td>Significance</td>
<td></td>
</tr>
<tr>
<td>------</td>
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<td>--------------</td>
<td></td>
</tr>
<tr>
<td>1192</td>
<td>uniting the Muslim world and recapturing Jerusalem.</td>
<td>battles, the Crusaders did not recapture Jerusalem.</td>
<td></td>
</tr>
<tr>
<td>1192</td>
<td>Minamoto no Yoritomo is appointed Sei-i Taishōgun, or shōgun for short.</td>
<td>He is the first of a long line of military dictators to bear this title. The institution would last until 1913.</td>
<td></td>
</tr>
<tr>
<td>1193</td>
<td>Muhammad bin Bakhtiyar Khilji sack and burn the university at Nalanda.</td>
<td>This is the beginning of the decline of Buddhism in India.</td>
<td></td>
</tr>
<tr>
<td>1193</td>
<td>The first known merchant guild.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1195</td>
<td>Battle of Alarcos The Almohad Caliphate decisively defeat the Kingdom of Castile.</td>
<td>The Almohads pushed Christians to the north and established themselves as the supreme power in Al-Andalus</td>
<td></td>
</tr>
<tr>
<td>1199</td>
<td>Europeans first use compasses.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**13th century**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1202</td>
<td>The Fourth Crusade sacked Croatian town of Zadar (Italian: Zara), a rival of Venice. Unable to raise enough funds to pay to their Venetian contractors, the crusaders agreed to sack the city despite letters from Pope Innocent III forbidding such an action and threatening excommunication.</td>
<td>Siege of Zara was the first major Crusade's action and the first attack against a Catholic city by Catholic crusaders.</td>
<td></td>
</tr>
<tr>
<td>1204</td>
<td>Sack of Constantinople during the Fourth Crusade.</td>
<td>Considered to be the beginning of the decline of the Byzantine Empire.</td>
<td></td>
</tr>
<tr>
<td>1205</td>
<td>Battle of Adrianople. The Bulgarians under Emperor Kaloyan defeat Baldwin I.</td>
<td>Beginning of the decline of the Latin Empire.</td>
<td></td>
</tr>
<tr>
<td>1206</td>
<td>Genghis Khan was elected as Khagan of the Mongols and the Mongol Empire was established.</td>
<td>The Mongols would conquer much of Eurasia, changing former political borders.</td>
<td></td>
</tr>
<tr>
<td>1208</td>
<td>Pope Innocent III calls for the Albigensian Crusade which seeks to destroy a rival form of Christianity practiced by the Cathars.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1209</td>
<td>The University of Cambridge is founded.</td>
<td>One of the more significant orders in</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
<td></td>
<td></td>
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<tr>
<td>------</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1212</td>
<td>Spanish Christians succeed in defeating the Moors in the long Reconquista campaigns, after the Battle of Las Navas de Tolosa.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1215</td>
<td>The Magna Carta is sealed by John of England.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1215</td>
<td>Fourth Lateran Council. Dealt with transubstantiation, papal primacy and conduct of clergy. Proclaimed that Jews and Muslims should wear identification marks to distinguish them from Christians.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1216</td>
<td>Papal recognition of the Dominican Order.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1219</td>
<td>Serbian Orthodox Church becomes autocephalous under St. Sava, its first Archbishop.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1227</td>
<td>Genghis Khan dies.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1237–1240</td>
<td>Mongol invasion of Rus' resumes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1257</td>
<td>Opening of the College of Sorbonne.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1258</td>
<td>Siege of Baghdad</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The Roman Catholic church, founded by Saint Francis of Assisi. By 1238, only the small southern Emirate of Granada remained under Muslim control. This marks one of the first times a medieval ruler is forced to accept limits on his power. His kingdom is divided among his children and grandchildren: Empire of the Great Khan, Chagatai Khanate, Mongolian Homeland, and the Blue Horde and White Horde (which would later become the Golden Horde). Causes the split of Kievan Rus' into three components (present day Russia, Ukraine, Belarus, greatly effects various regions of raided lands in other parts of Europe; Golden Horde formed. This establishes a new form of government-limited regal authority. Mongols (the Ilkhanate) ensure control of the region; Generally considered the end of the Islamic
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>February</td>
<td>The first Mongol invasion of Vietnam</td>
<td>The Mongol army was defeated by emperor Tran Thai Tong of Đại Việt</td>
</tr>
<tr>
<td>1258</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1272–73</td>
<td>The Ninth Crusade occurs.</td>
<td>Considered to be the Last Major Crusade to take place in the Holy Land.</td>
</tr>
<tr>
<td>1273</td>
<td>Rudolph I of Germany is elected Holy Roman Emperor.</td>
<td>This begins the Habsburg <em>de facto</em> domination of the crown that lasted until 1806.</td>
</tr>
<tr>
<td>1274</td>
<td>Thomas Aquinas' work, <em>Summa Theologica</em> is published, after his death.</td>
<td>Is the main staple of theology during the Middle Ages.</td>
</tr>
<tr>
<td>1279</td>
<td>Battle of Yamen.</td>
<td>Marks the end of the Song Dynasty in China, and all of China is under the rule of Kublai Khan as the emperor.</td>
</tr>
<tr>
<td>1282</td>
<td>Sicilian Vespers. Sicilians massacre Angevins over a six-week period, after a Frenchman harassed a woman.</td>
<td>Would mark a two decade period of war, and peace treaties mainly between Aragon, Sicily, and the Angevins.</td>
</tr>
<tr>
<td>1283</td>
<td>First regulated Catalan Courts.</td>
<td>Presided by king Peter III of Aragon for the whole Principality of Catalonia, it became in one of the first parliamentary bodies that banned the royal power to create legislation unilaterally.</td>
</tr>
<tr>
<td>1285</td>
<td>The second Mongol invasion of Vietnam</td>
<td>The Mongol army was defeated by emperor Tran Nhan Tong and general Tran Hung Dao.</td>
</tr>
<tr>
<td>1287</td>
<td>The third Mongol invasion of Vietnam</td>
<td>Decisive Vietnam victory. To avoid further conflict, Đại Việt agreed to a tributary relationship with the Yuan dynasty</td>
</tr>
<tr>
<td>1296</td>
<td>Edward I of England invades Scotland, starting the First War of Scottish Independence.</td>
<td></td>
</tr>
<tr>
<td>1297</td>
<td>The Battle of Stirling Bridge.</td>
<td>William Wallace emerges as the leader of the Scottish resistance to England.</td>
</tr>
<tr>
<td>1298</td>
<td>Marco Polo publishes his tales of China, along</td>
<td>A key step to the bridging of Asia and</td>
</tr>
</tbody>
</table>
with Rustichello da Pisa. Europe in trade.

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1299</td>
<td>27 July</td>
<td>The Ottoman Empire is founded by Osman I.</td>
<td>Becomes longest lasting Islamic Empire, lasting over 600 years into the 20th century.</td>
</tr>
</tbody>
</table>

14th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1305</td>
<td>Wednesday August 23</td>
<td>William Wallace is executed for treason.</td>
<td></td>
</tr>
<tr>
<td>1307</td>
<td>Friday, October 13th</td>
<td>The Knights Templar are rounded up and murdered by Philip the Fair of France, with the backing of the Pope.</td>
<td>Hastens the demise of the order within a decade.</td>
</tr>
<tr>
<td>1307</td>
<td></td>
<td>Beginning of the Babylonian Captivity of the Papacy during which the Popes moved to Avignon.</td>
<td>Begins a period of over seven decades of the Papacy outside of Rome that would be one of the major factors of the Western Schism.</td>
</tr>
<tr>
<td>1310</td>
<td></td>
<td>Dante publishes his <em>Divine Comedy</em>.</td>
<td>Is one of the most defining works of literature during the Late Middle Ages, and among the most recognizable in all of literature.</td>
</tr>
<tr>
<td>1314</td>
<td>23–24 June</td>
<td>Battle of Bannockburn.</td>
<td>Robert the Bruce restores Scotland's <em>de facto</em> independence.</td>
</tr>
<tr>
<td>1325</td>
<td></td>
<td>The Mexica found the city of Tenochtitlan.</td>
<td>This would later be the epicenter and capital of the Aztec Empire until the Siege of Tenochtitlan 200 years later.</td>
</tr>
<tr>
<td>1328</td>
<td></td>
<td>The First War of Scottish Independence ends in Scottish victory with the Treaty of Edinburgh-Northampton and <em>de jure</em> independence.</td>
<td></td>
</tr>
<tr>
<td>1323</td>
<td></td>
<td>Romance of the three kingdoms</td>
<td></td>
</tr>
<tr>
<td>1330</td>
<td>28 July</td>
<td>Battle of Velbazhd.</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
<td>Details</td>
<td></td>
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</tr>
<tr>
<td>1333</td>
<td>Emperor Go-Daigo returns to the throne from exile, and begins the Kenmu restoration.</td>
<td>The Kamakura Shogunate comes to an end, and the Kenmu Restoration only lasts a few years before the Ashikaga Shogunate begins.</td>
<td></td>
</tr>
<tr>
<td>1337</td>
<td>The Hundred Years’ War begins. England and France struggle for a dominating position in Europe and their region.</td>
<td>The war will span through three/four different war periods within a 116-year period.</td>
<td></td>
</tr>
</tbody>
</table>
| 1346 | August 26th | Battle of Crécy. 
English forces led by Edward III and Edward, the Black Prince defeat the French forces of Philip VI despite being outnumbered at least 4 to 1, with the longbow being a major factor in favor of England. Also considered to be the beginning of the end of classic chivalry. |
<p>| 1347 | The Black Death ravages Europe for the first of many times. An estimated 20% – 40% of the population is thought to have perished within the first year. | The first of many concurrences of this plague, This was believed to have wiped out as many as 50% of Europe's population by its end. |
| 1347 | The University of Prague is founded. | It is the oldest Czech and German-Speaking University in the world |
| 1364 | Astrarium | Giovanni de dondi |
| 1368 | The fall of the Yuan Dynasty. Its remnants, known as Northern Yuan, continued to rule Mongolia. | The breakup of the Mongol Empire, which marked the end of Pax Mongolica. |
| 1370 | Tamerlane establishes the Timurid Dynasty. | During this 35-year period, Tamerlane would ravage his fellow Islamic states such as the Golden Horde and the Delhi Sultanate in order to accomplish his goal of a restored Mongol Empire. |
| 1371 | King Marko's realm is established, the capital is located in Prilep. | |
| 1378 | The Western Schism during which three claimant popes were elected simultaneously. | The Avignon Papacy ends. |</p>
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1380</td>
<td>Prince Dmitry Donskoy of Moscow led a united Russian army to a victory over the Mongols in the Battle of Kulikovo.</td>
<td>Chaucer's greatest work, and one of the foundations towards the formation of the Modern English language</td>
</tr>
<tr>
<td>1380</td>
<td>Chaucer begins to write The Canterbury Tales.</td>
<td>Chaucer's greatest work, and one of the foundations towards the formation of the Modern English language</td>
</tr>
<tr>
<td>1381</td>
<td>Peasants' Revolt in England.</td>
<td>Quickest-spread revolt in English history, and the most popular revolt of the Late Middle Ages.</td>
</tr>
<tr>
<td>1381</td>
<td>The Bible is translated into English by John Wycliffe.</td>
<td>First print published in English (Vulgate)</td>
</tr>
<tr>
<td>1386</td>
<td>October 18–19th</td>
<td>The University of Heidelberg is founded.</td>
</tr>
<tr>
<td>1389</td>
<td>June 28th</td>
<td>The University of Heidelberg is founded.</td>
</tr>
<tr>
<td>1396</td>
<td>The Battle of Nicopolis.</td>
<td>The last great Crusade fails. Bulgaria was conquered by the Ottomans</td>
</tr>
<tr>
<td>1397</td>
<td>The Kalmar Union is formed.</td>
<td>Queen Margaret I of Denmark unites the Denmark, Sweden, and Norway, and lasts until 1523.</td>
</tr>
</tbody>
</table>

15th century (until 1492)
<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1402</td>
<td>July 20th</td>
<td>Battle of Ankara</td>
<td>Bayezid I is captured by Tamerlane's forces, causing the interregnum of the Ottoman Empire.</td>
</tr>
<tr>
<td>1405</td>
<td></td>
<td>Chinese naval expeditions of Southeast Asia and the Indian Ocean (to Eastern Africa) begin, under the leadership of Zheng He.</td>
<td>This will be the first of seven of the Ming Dynasty-sponsored expeditions, lasting until 1433.</td>
</tr>
<tr>
<td>1409</td>
<td></td>
<td>Ladislaus of Naples sells his &quot;rights&quot; on Dalmatia to the Venetian Republic for 100,000 ducats.</td>
<td>Dalmatia would with some interruptions remain under Venetian rule for nearly four centuries, until 1797.</td>
</tr>
<tr>
<td>1410</td>
<td></td>
<td>Battle of Grunwald</td>
<td>Major turning point in history of Lithuania, Poland and the Teutonic Order.</td>
</tr>
<tr>
<td>1415</td>
<td>October 25</td>
<td>Battle of Agincourt. Henry V and his army defeat a numerically superior French army, partially because of the newly introduced English longbow.</td>
<td>The turning point in the Hundred Years' War for 15th-century England that leads to the signing of the Treaty of Troyes five years later, making Henry V heir to the throne of France.</td>
</tr>
<tr>
<td>1417</td>
<td></td>
<td>The Council of Constance ends.</td>
<td>The Western Schism comes to a close, and elects Pope Martin V as the sole pope.</td>
</tr>
<tr>
<td>1419</td>
<td></td>
<td>Hussite Wars begin after four years after the death of Jan Hus in central Europe, dealing with the followers of Jan Hus and those against them.</td>
<td>Although the war was a stalemate (ended around 1434), it was another factor that between the Catholics and Protestants before the Protestant Reformation.</td>
</tr>
<tr>
<td>1428</td>
<td></td>
<td>Itzcoatl, the fourth Mexico king in Tenochtitlán, allied with Texcoco and Tlacopan, defeats Azcapotzalco.</td>
<td>Signifies the birth of the Aztec Empire and the start of an aggressive expansion lasting 90 years. Itzcoatl and his men began burning historic hieroglyphic books of conquered states, rewriting history with the Mexica at its center.</td>
</tr>
<tr>
<td>1429</td>
<td></td>
<td>Joan of Arc lifts the siege of Orléans for the Dauphin of France, enabling him to eventually be crowned at Reims.</td>
<td>The battle at Orléans is the first of many which ultimately drive the English from continental Europe.</td>
</tr>
<tr>
<td>1431</td>
<td>30 May</td>
<td>Trial and execution of Joan of Arc.</td>
<td>Death of the woman who helped turn the Hundred Years' War in favor of the French over the past two years.</td>
</tr>
<tr>
<td>1434</td>
<td></td>
<td>The Medici family rises to prominence in Florence.</td>
<td>This ushers in a period of significance of the Medicis, such as bankers, popes, queens (regents)</td>
</tr>
</tbody>
</table>
and dukes, throughout Europe (mainly Italy, especially the Florentine Republic), over the next three centuries.

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1434</td>
<td>Aronolfini Portrait Jan Van Eyck</td>
<td>Evidence on usage of convex mirror</td>
</tr>
<tr>
<td>1438</td>
<td>Prince Cusi Yupanqui becomes the first Inca emperor.</td>
<td>Inca civilization begins expanding and the Inca Empire is born.[24]</td>
</tr>
<tr>
<td>1439</td>
<td>Johannes Gutenberg invents the printing press.</td>
<td>Literature, news, etc. becomes more accessible throughout Europe.</td>
</tr>
<tr>
<td>1442</td>
<td>Battle of Szeben</td>
<td>Third significant victory for the Hungarian forces led by Janos Hunyadi over the Ottoman forces.</td>
</tr>
<tr>
<td>1443</td>
<td>Sejong the Great creates Hangul</td>
<td>Koreans gain an alphabet suited to their language</td>
</tr>
<tr>
<td>1444</td>
<td>November 10 Battle of Varna</td>
<td>Final battle of the Crusade of Varna; Ottomans are victorious over the Hungarian-Polish armies, and Władysław III of Poland dies.</td>
</tr>
<tr>
<td>1452</td>
<td>Coronation of Frederick III</td>
<td></td>
</tr>
<tr>
<td>1453</td>
<td>Constantinople falls to the Ottoman Turks.</td>
<td>End of the Byzantine Empire (or Eastern Roman Empire to some); Constantinople becomes capital of Ottoman Empire.</td>
</tr>
<tr>
<td>1455</td>
<td>The Hundred Years' War ends.</td>
<td>England's once vast territory in France is now reduced to only Calais, which they eventually lose control of as well.</td>
</tr>
<tr>
<td>1456</td>
<td>May 22 Battle of St. Albans</td>
<td>Traditionally marks the beginning of the War of the Roses.</td>
</tr>
<tr>
<td>1457</td>
<td>Siege of Belgrade</td>
<td>Major Ottoman advances are halted for seven decades; last major victory for Hunyadi.</td>
</tr>
<tr>
<td>1459</td>
<td>Smederevo falls under the Turks</td>
<td>Marks the end of the Medieval Serbian state.</td>
</tr>
<tr>
<td>1461</td>
<td>The Empire of Trebizond falls to the Ottoman Turks.</td>
<td>Last Roman outpost to be conquered by the Ottomans.</td>
</tr>
<tr>
<td>1464</td>
<td>Dardanelles gun</td>
<td>Turkish Munir Ali</td>
</tr>
<tr>
<td>1467–1477</td>
<td>Ōnin War takes place in Japan.</td>
<td>First of many significant civil wars between shogunates that would continue for another century during the Muromachi period.</td>
</tr>
<tr>
<td>1475</td>
<td>The Khanate of Crimea is conquered and made a vassal state by the Ottoman Empire.</td>
<td>Venice is defeated and the Ottoman Empire becomes master of the Aegean Sea.</td>
</tr>
<tr>
<td>1485</td>
<td>Thomas Malory composes <em>Le Morte d'Arthur</em></td>
<td>Perhaps the best-known work of Arthurian literature in English.</td>
</tr>
</tbody>
</table>
1485 August 22nd Battle of Bosworth Field. Richard III dies in battle, and Henry Tudor becomes king of England; last shift of Houses/kingship during the War of the Roses.

1487 June 16 Battle of Stoke. Marks end of the War of the Roses.

1492 Reconquista ends. Marks end of Moorish-Muslim rule within Iberian Peninsula; Unification of Spain.

1492 Christopher Columbus reaches the New World. Age of Discovery into the New World begins.

15th century (after 1492)

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1494</td>
<td>June 10</td>
<td>Spain and Portugal sign the Treaty of Tordesillas and agree to divide the World outside of Europe between themselves.</td>
<td>Pope's ruling will lead to the division of Brazil and Spanish America, as well as the formation of the Spanish Philippines and Portuguese colonies in India and Africa.</td>
</tr>
<tr>
<td>1494–1559</td>
<td></td>
<td>The Italian Wars.</td>
<td>Italian Wars will eventually lead to the downfall of the Italian city-states.</td>
</tr>
<tr>
<td>1497</td>
<td></td>
<td>Vasco da Gama begins his first voyage from Europe to India and back.</td>
<td>Vasco da Gama was the first European to sail directly to Eastern Asia from Europe.</td>
</tr>
<tr>
<td>1499</td>
<td></td>
<td>Ottoman fleet defeats Venetians at the Battle of Zonchio.</td>
<td>The first naval battle that used cannons in ships.</td>
</tr>
</tbody>
</table>

Timeline of women in the United States

- 1756: Lydia Taft is the first woman to vote legally in Colonial America.
- 1821: Emma Willard founds the Troy Female Seminary in New York; it is the first school in the country founded to provide young women with a college-level education.
- 1837: The first American convention held to advocate women's rights was the 1837 Anti-Slavery Convention of American Women held in 1837.
- 1837: Oberlin College becomes the first American college to admit women.
- 1840: The first petition for a law granting married women the right to own property was established in 1840.
- 1845: Lowell Female Labor Reform Association opened in 1845 as the first major labor union.
1848: The Seneca Falls Convention, the first women's rights convention, is held in Seneca Falls, New York.

1855: New York Women's Hospital opened in 1855 as the first hospital solely devoted to ailments affiliated with women.

1869: Wyoming is the first territory to give women the right to vote.

1870: Louisa Ann Swain is the first woman in the United States to vote in a general election. She cast her ballot on September 6, 1870, in Laramie, Wyoming.

1870: The first all-female jury in America is sworn in March 7, 1870 in Laramie, Wyoming.

1874: Mary Ewing Outerbridge, from Staten Island, introduces tennis to America, creating the first American tennis court at the Staten Island Cricket and Baseball Club.

1892: The first women's basketball game was played at Smith College, and conducted by Senda Berenson.

1916: Jeannette Rankin becomes the first woman to hold high office in the United States when she is elected to Congress, as a Republican from Montana.

1916: The first birth control clinic in America is opened by Margaret Sanger.

1940: The first social security beneficiary was Ida May Fuller, she received check 00-000-001 in the amount of $22.54.


1965: In Griswold v. Connecticut, the Supreme Court rules that Connecticut's ban on the use of contraceptives violates the right to marital privacy.

1972: The US Congress passes the Equal Rights Amendment, which stipulates that "Equality of rights under the law shall not be denied or abridged by the United States or by any State on account of sex."

1972: Title IX is passed as a portion of the Education Amendments of 1972, which states (in part) that: "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving federal financial assistance."

1973: Roe vs. Wade rules unconstitutional a state law that banned abortions except to save the life of the mother. The Supreme Court rules that the states are forbidden from outlawing or regulating any aspect of abortion performed during the first trimester of pregnancy, can only enact abortion regulations reasonably related to maternal health in the second and third trimesters, and can enact abortion laws protecting the life of the fetus only in the third trimester. Even then, an exception has to be made to protect the life of the mother.

- 1980: Women first graduated from the U.S. service academies.
- 1989: In Webster v. Reproductive Health Services, the Supreme Court upheld a Missouri law that imposed restrictions on the use of state funds, facilities, and employees in performing, assisting with, or counseling on abortions.
- 1996: In United States v. Virginia, the US Supreme Court struck down the Virginia Military Institute (VMI)'s long-standing male-only admission policy in a 7-1 decision.
- 2009: The Lilly Ledbetter Fair Pay Act of 2009 is signed into law, which states that the 180-day statute of limitations for filing an equal-pay lawsuit regarding pay discrimination resets with each new paycheck affected by that discriminatory action.
- 2016: Former First Lady, Senator of New York, and Secretary of State Hillary Clinton clinches the nomination for the Democratic Party, becoming the first female candidate for President on the ballot of a major party.

Timeline of project management

Early civilizations

- 2570 BC Great pyramid of Giza completed. Some records remain of how the work was managed: e.g. there were managers of each of the four faces of the pyramid, responsible for their completion (subproject managers).
- 208 BC The first major construction of the Great Wall of China.

15th - 19th century

- Christopher Wren (1632–1723) was a 17th-century English designer, astronomer, geometer, mathematician-physicist and architect. Wren designed 55 of 87 London churches after the Great fire of London in 1666, such as St Paul's Cathedral in 1710, as well as many secular buildings.
- Thomas Telford (1757-1834) was a Scottish stonemason, architect and civil engineer and a road, bridge and canal builder, who managed the Ellesmere Canal and Pontcysyllte Aqueduct.
- Isambard Kingdom Brunel (1806–1859) was a British engineer who created the Great Western Railway, a series of steamships, such as the first with a propeller, and numerous bridges and tunnels.
20th century

- 1910s The Gantt chart developed by Henry Laurence Gantt (1861–1919)

1950s

- 1950s The Critical path method (CPM) invented
- 1950s The US DoD used modern project management techniques in their Polaris project.
- 1956 The American Association of Cost Engineers (now AACE International) formed
- 1958 The Program Evaluation and Review Technique (PERT) method invented

1960s

- 1969 Project Management Institute (PMI) launched to promote project management profession

1970s

- 1975 PROMPT methodology (acronym for Project Resource Organisation Management Planning Technique) created by Simpact Systems Ltd
- 1975 The Mythical Man-Month: Essays on Software Engineering by Fred Brooks published

1980s

- 1984 The Goal by Eliyahu M. Goldratt published
- 1986 Scrum was named as a project management style in the article The New New Product Development Game by Takeuchi and Nonaka
- 1987 First Project Management Body of Knowledge Guide published as a white paper by PMI
- 1989 PRINCE method derived from PROMPTII is published by the UK Government agency CCTA and becomes the UK standard for all government information projects

1990s

- 1996 PRINCE2 published by CCTA (now Office of Government Commerce OGC) as a generic product management methodology for all UK government projects.
- 1997 Critical Chain by Eliyahu M. Goldratt published
21st century

- 2001 AgileAlliance formed to promote "lightweight" software development projects
- 2006 Total Cost Management Framework release by AACE
- 2009 PRINCE2 2009 edition, compatible with other methods and more flexible in approach

Timeline of knowledge about galaxies, clusters of galaxies, and large-scale structure

Pre-20th century

- 5th century BC — Democritus proposes that the bright band in the night sky known as the Milky Way might consist of stars,
- 4th century BC — Aristotle believes the Milky Way to be caused by "the ignition of the fiery exhalation of some stars which were large, numerous and close together" and that the "ignition takes place in the upper part of the atmosphere, in the region of the world which is continuous with the heavenly motions",
- 964 — Abd al-Rahman al-Sufi (Azophi), a Persian astronomer, makes the first recorded observations of the Andromeda Galaxy and the Large Magellanic Cloud in his *Book of Fixed Stars*, and which are the first galaxies other than the Milky Way to be observed from Earth,
- 11th century — Abū Rayḥān al-Bīrūnī, another Persian astronomer, describes the Milky Way galaxy as a collection of numerous nebulous stars,
- 11th century — Alhazen (Ibn al-Haytham), an Arabian astronomer, refutes Aristotle's theory on the Milky Way by making the first attempt at observing and measuring the Milky Way's parallax, and he thus "determined that because the Milky Way had no parallax, it was very remote from the Earth and did not belong to the atmosphere",
- 12th century — Avempace (Ibn Bajjah) of Islamic Spain proposes the Milky Way to be made up of many stars but that it appears to be a continuous image due to the effect of refraction in the Earth's atmosphere,
- 14th century — Ibn Qayyim Al-Jawziyya of Syria proposes the Milky Way galaxy to be "a myriad of tiny stars packed together in the sphere of the fixed stars" and that these stars are larger than planets,
- 1521 — Ferdinand Magellan observes the Magellanic Clouds during his circumnavigating expedition,
- 1610 — Galileo Galilei uses a telescope to determine that the bright band on the sky, the "Milky Way", is composed of many faint stars
- 1750 — Thomas Wright discusses galaxies and the flattened shape of the Milky Way and speculates nebulae as separate
• 1755 — Immanuel Kant drawing on Wright's work conjectures our galaxy is a rotating disk of stars held together by gravity, and that the nebulae are separate such galaxies; he calls them Island Universes

• 1785 — William Herschel carried the first attempt to describe the shape of the Milky Way and the position of the Sun in it by carefully counting the number of stars in different regions of the sky. He produced a diagram of the shape of the galaxy with the solar system close to the center.

• 1845 — Lord Rosse discovers a nebula with a distinct spiral shape

**Early 20th century**

• 1912 — Vesto Slipher spectrographic studies of spiral nebulae find high Doppler shifts indicating recessional velocity.

• 1917 — Heber Curtis find novae in Andromeda Nebula M31 were ten magnitudes fainter than normal giving a distance estimate of 150,000 parsecs supporting the "island universes" or independent galaxies hypothesis for spiral nebulae.

• 1918 — Harlow Shapley demonstrates that globular clusters are arranged in a spheroid or halo whose center is not the Earth, and hypothesizes, correctly, that its center is the Galactic Center of the galaxy,

• 26 April 1920 — Harlow Shapley and Heber Curtis debate whether Andromeda Nebula is within the Milky Way. Curtis notes dark lanes in Andromeda resembling the dust clouds in the Milky Way, as well as significant Doppler shift.

• 1922 — Ernst Öpik distance determination supports Andromeda as extra-galactic object.

• 1923 — Edwin Hubble resolves the Shapley–Curtis debate by finding Cepheids in the Andromeda Galaxy, definitively proving that there are other galaxies beyond the Milky Way.

• 1930 — Robert Trumpler uses open cluster observations to quantify the absorption of light by interstellar dust in the galactic plane; this absorption had plagued earlier models of the Milky Way.

• 1932 — Karl Guthé Jansky discovers radio noise from the center of the Milky Way,

• 1933 — Fritz Zwicky applies the virial theorem to the Coma Cluster and obtains evidence for unseen mass,

• 1936 — Edwin Hubble introduces the spiral, barred spiral, elliptical, and irregular galaxy classifications,

• 1939 — Grote Reber discovers the radio source Cygnus A,

• 1943 — Carl Keenan Seyfert identifies six spiral galaxies with unusually broad emission lines, named Seyfert galaxies,

• 1949 — J. G. Bolton, G. J. Stanley, and O. B. Slee identify NGC 4486 (M87) and NGC 5128 as extragalactic radio sources,
1953 — Gérard de Vaucouleurs discovers that the galaxies within approximately 200 million light-years of the Virgo Cluster are confined to a giant supercluster disk,

1954 — Walter Baade and Rudolph Minkowski identify the extragalactic optical counterpart of the radio source Cygnus A,

1959 — Hundreds of radio sources are detected by the Cambridge Interferometer which produces the 3C catalogue. Many of these are later found to be distant quasars and radio galaxies

1960 — Thomas Matthews determines the radio position of the 3C source 3C 48 to within 5",

1960 — Allan Sandage optically studies 3C 48 and observes an unusual blue quasistellar object,

1962 — Cyril Hazard, M. B. Mackey, and A. J. Shimmins use lunar occultations to determine a precise position for the quasar 3C 273 and deduce that it is a double source,

1962 — Olin Eggen, Donald Lynden-Bell, and Allan Sandage theorize galaxy formation by a single (relatively) rapid monolithic collapse, with the halo forming first, followed by the disk.

1963 — Maarten Schmidt identifies the redshifted Balmer lines from the quasar 3C 273

1973 — Jeremiah Ostriker and James Peebles discover that the amount of visible matter in the disks of typical spiral galaxies is not enough for Newtonian gravitation to keep the disks from flying apart or drastically changing shape,

1973 — Donald Gudehus finds that the diameters of the brightest cluster galaxies have increased due to merging, the diameters of the faintest cluster galaxies have decreased due to tidal distention, and that the Virgo cluster has a substantial peculiar velocity,

1974 — B. L. Fanaroff and J. M. Riley distinguish between edge-darkened (FR I) and edge-brightened (FR II) radio sources,

1976 — Sandra Faber and Robert Jackson discover the Faber-Jackson relation between the luminosity of an elliptical galaxy and the velocity dispersion in its center. In 1991 the relation is revised by Donald Gudehus,

1977 — R. Brent Tully and Richard Fisher publish the Tully–Fisher relation between the luminosity of an isolated spiral galaxy and the velocity of the flat part of its rotation curve,

1978 — Steve Gregory and Laird Thompson describe the Coma supercluster,

1978 — Donald Gudehus finds evidence that clusters of galaxies are moving at several hundred kilometers per second relative to the cosmic microwave background radiation,

1978 — Vera Rubin, Kent Ford, N. Thonnard, and Albert Bosma measure the rotation curves of several spiral galaxies and find significant deviations from what is predicted by the Newtonian gravitation of visible stars,
• 1978 — Leonard Searle and Robert Zinn theorize that galaxy formation occurs through the merger of smaller groups.

**Late 20th century**

• 1981 — Robert Kirshner, August Oemler, Paul Schechter, and Stephen Shectman find evidence for a giant void in Boötes with a diameter of approximately 100 million light years,

• 1985 — Robert Antonucci and J. Miller discover that the Seyfert II galaxy NGC 1068 has broad lines which can only be seen in polarized reflected light,

• 1986 — Amos Yahil, David Walker, and Michael Rowan-Robinson find that the direction of the IRAS galaxy density dipole agrees with the direction of the cosmic microwave background temperature dipole,

• 1987 — David Burstein, Roger Davies, Alan Dressler, Sandra Faber, Donald Lynden-Bell, R. J. Terlevich, and Gary Wegner claim that a large group of galaxies within about 200 million light years of the Milky Way are moving together towards the "Great Attractor" in the direction of Hydra and Centaurus,

• 1987 — R. Brent Tully discovers the Pisces±Cetus Supercluster Complex, a structure one billion light years long and 150 million light years wide,

• 1989 — Margaret Geller and John Huchra discover the "Great Wall", a sheet of galaxies more than 500 million light years long and 200 million wide, but only 15 million light years thick,

• 1990 — Michael Rowan-Robinson and Tom Broadhurst discover that the IRAS galaxy IRAS F10214+4724 is the brightest known object in the Universe,

• 1991 — Donald Gudehus discovers a serious systematic bias in certain cluster galaxy data (surface brightness vs. radius parameter, and the Dn method) which affect galaxy distances and evolutionary history; he devises a new distance indicator, the reduced galaxian radius parameter, $r_g$, which is free of biases,

• 1992 — First detection of large-scale structure in the Cosmic microwave background indicating the seeds of the first clusters of galaxies in the early Universe

• 1995 — First detection of small-scale structure in the cosmic microwave background

• 1995 — Hubble Deep Field survey of galaxies in field 144 arc seconds across.

• 1998 — The 2dF Galaxy Redshift Survey maps the large-scale structure in a section of the Universe close to the Milky Way

• 1998 — Hubble Deep Field South

• 1998 — Discovery of accelerating universe
- 2000 — Data from several cosmic microwave background experiments give strong evidence that the Universe is "flat" (space is not curved, although space-time is), with important implications for the formation of large-scale structure

**Early 21st century**

- 2001 — First data release from the ongoing Sloan Digital Sky Survey
- 2004 — The European Southern Observatory discovers Abell 1835 IR1916, the most distant galaxy yet seen from Earth.
- 2004 — The Arcminute Microkelvin Imager begins to map the distribution of distant clusters of galaxies
- 2004 — Spitzer Space Telescope data confirm what had been considered likely since the early 1990s from radio telescope data, i.e., that the Milky Way Galaxy is a barred spiral galaxy.
- 2012 — Astronomers report the discovery of the most distant dwarf galaxy yet found, approximately 10 billion light-years away.
- 2012 — The Huge-LQG, a large quasar group, one of the largest known structures in the universe, is discovered.
- 2013 — The galaxy Z8 GND 5296 is confirmed by spectroscopy to be one of the most distant galaxies found up to this time. Formed just 700 million years after the Big Bang, expansion of the universe has carried it to its current location, about 13 billion light years away from Earth.
- 2013 — The Hercules–Corona Borealis Great Wall, a massive galaxy filament and the largest known structure in the universe, was discovered through gamma-ray burst mapping.

**Timeline of scientific thought**

<table>
<thead>
<tr>
<th>chronological period</th>
<th>Scientific thought</th>
</tr>
</thead>
<tbody>
<tr>
<td>3rd millennium BC</td>
<td>Sexagesimal (base 60) numeral system originated with the ancient Sumerians</td>
</tr>
<tr>
<td>4th century BCE</td>
<td>Axiomatic science based on the logico-deductive method is founded owing to Euclid's Elements Publication which is at the root of formal system.</td>
</tr>
<tr>
<td>3rd century BCE</td>
<td>Eratosthenes: calculated the size of the earth and its distance to the sun and to the moon</td>
</tr>
<tr>
<td>150s BCE</td>
<td>Seleucus of Seleucia: discovery of tides being caused by the moon...</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
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<tr>
<td>-----------</td>
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</tr>
<tr>
<td>5th century CE</td>
<td>Hindu-Arabic numeral system (decimal) begins to be used</td>
</tr>
<tr>
<td>630</td>
<td>Abiyun al-Bitriq: Early astronomical instruments</td>
</tr>
<tr>
<td>721-815</td>
<td>Jabir ibn Hayyan: Father of chemistry. Did influential work on chemistry and chemical apparatus</td>
</tr>
<tr>
<td>776-869</td>
<td>Al-Jahiz: Very first scientist to discuss on natural selection in his &quot;Book of Animal&quot;</td>
</tr>
<tr>
<td>780-850</td>
<td>Muhammad ibn Musa al-Khwarizmi: Foundation of modern Algebra and Algorithm</td>
</tr>
<tr>
<td>806</td>
<td>Muhammad ibn Ibrāhīm al-Fazārī: Invented first astrolabe for navigation</td>
</tr>
<tr>
<td>801-873</td>
<td>Al-Kindi: Father of cryptography, cryptanalysis and frequency analysis</td>
</tr>
<tr>
<td>858-929</td>
<td>Al-Battani: Produced many Trigonometric formulas; Calculation of the values for the precession of the equinoxes (54.5'' per year, or 1° in 66 years) and the obliquity of the ecliptic (23° 35')</td>
</tr>
<tr>
<td>859</td>
<td>Fatima al-Fihri: Founded world's first &amp; oldest degree granting university- &quot;University of al-Qarawiyyin&quot;</td>
</tr>
<tr>
<td>973-1050</td>
<td>Al-Beruni: Foundation of Chronology and Indology</td>
</tr>
<tr>
<td>10th century CE</td>
<td>Muhammad ibn Zakařyā Rāzi (Rhazes): refutation of Aristotelian classical elements and Galenic humorism; and discovery of measles and smallpox, and kerosene and distillated petroleum</td>
</tr>
<tr>
<td>1021</td>
<td>Ibn al-Haytham's <em>Book of Optics</em>: First accurate vision theory, Father of scientific method</td>
</tr>
<tr>
<td>1020s</td>
<td>Avicenna's <em>The Canon of Medicine</em>: Standard medical textbook in europe for 600 years</td>
</tr>
<tr>
<td>1027s</td>
<td>Avicenna's <em>Book of Healing</em>: First accurate description of Newton's First Law of Motion</td>
</tr>
<tr>
<td>1048-1131</td>
<td>Omar Khayyam: Geometric Algebra, a precursor to Descartes' Analytic Geometry; Solution of cubic equations</td>
</tr>
<tr>
<td>1058-1111</td>
<td>Al-Ghazali: Logic, Philosophy, Business Ethics</td>
</tr>
<tr>
<td>1121</td>
<td>Al-Khazini: variation of gravitation and gravitational potential energy at a distance; the decrease of air density with altitude</td>
</tr>
<tr>
<td>1135-1213</td>
<td>Sharaḍ al-Dīn al-Tūsī: Invented linear Astrolabe; First to propose the idea of a mathematical function</td>
</tr>
<tr>
<td>12th century</td>
<td>Ibn Bajjah (Avempace): discovery of reaction (precursor to Newton's third law of motion)</td>
</tr>
<tr>
<td>12th century</td>
<td>Hibat Allah Abū'l-Barakat al-Baghdādī (Nathanel): relationship between force and acceleration (a vague foreshadowing of a fundamental law of classical mechanics and a precursor to Newton's second law of motion)</td>
</tr>
<tr>
<td>1206</td>
<td>Ismail al-Jazari Inventor of classic Automata, Segmental Gear, Crankshaft, Camshaft that drives modern world</td>
</tr>
<tr>
<td>12th century</td>
<td>Averroes: relationship between force, work and kinetic energy</td>
</tr>
<tr>
<td>1220–1235</td>
<td>Robert Grosseteste: rudiments of the scientific method (see also: Roger Bacon)</td>
</tr>
<tr>
<td>1242</td>
<td>Ibn al-Nafis: pulmonary circulation and circulatory system</td>
</tr>
<tr>
<td>1247</td>
<td>Nasir al-Dīn al-Tūsī: Invention of famous Tusi Couple</td>
</tr>
<tr>
<td>13th Century</td>
<td>Ibn al-Shāṭir: Production of a new lunar model</td>
</tr>
<tr>
<td>13th century</td>
<td>Theodoric of Freiberg: Correct explanation of rainbow phenomenon</td>
</tr>
<tr>
<td>13th century</td>
<td>William of Saint-Cloud: pioneering use of camera obscura to view solar eclipses</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
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<td>------</td>
<td>----------------------------------------------------------------------</td>
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<tr>
<td>Before 1327</td>
<td>William of Ockham: Occam's Razor</td>
</tr>
<tr>
<td>1332-1406</td>
<td>Ibn Khaldun: Pioneer of historiography, sociology, demography and economics</td>
</tr>
<tr>
<td>1429</td>
<td>Ulugh Beg: astronomy-related mathematics, trigonometry and spherical geometry</td>
</tr>
<tr>
<td>1460</td>
<td>Ali Qushji: Development of astronomical physics</td>
</tr>
<tr>
<td>1494</td>
<td>Luca Pacioli: first codification of the Double-entry bookkeeping system, which slowly developed in previous centuries</td>
</tr>
<tr>
<td>1430-1500</td>
<td>Ahmad ibn Mājīd: Navigator and Cartographer; Guided Vasco da Gama to complete the first all water trade route between Europe and India</td>
</tr>
<tr>
<td>1543</td>
<td>Copernicus: heliocentric model</td>
</tr>
<tr>
<td>1550</td>
<td>Taqi ad-Din Muhammad ibn Ma'ruf: Invented steam turbine -today known as Steam Jacks</td>
</tr>
<tr>
<td>1570s</td>
<td>Tycho Brahe: detailed astronomical observations</td>
</tr>
<tr>
<td>1600</td>
<td>William Gilbert: Earth's magnetic field</td>
</tr>
<tr>
<td>1609</td>
<td>Johannes Kepler: first two laws of planetary motion</td>
</tr>
<tr>
<td>1610</td>
<td>Galileo Galilei: Sidereus Nuncius: telescopic observations</td>
</tr>
<tr>
<td>1614</td>
<td>John Napier: use of logarithms for calculation</td>
</tr>
<tr>
<td>1628</td>
<td>William Harvey: Blood circulation</td>
</tr>
<tr>
<td>17th century</td>
<td>René Descartes creates Cartesian coordinate system — allowing reference to a point in space as a set of numbers, and allowing algebraic equations to be expressed as geometric shapes in a two-dimensional coordinate system (and conversely, shapes to be described as equations).</td>
</tr>
<tr>
<td>17th Century</td>
<td>Baruch Spinoza – opposed Cartesian mind body dualism. He considered the nature of reality of physical and mental worlds to be the same. Spinoza was determinist and believed that even human behaviour is fully determined, with freedom being our capacity to know and accept that we are determined.</td>
</tr>
<tr>
<td>1665</td>
<td>Philosophical Transactions of the Royal Society first peer reviewed scientific journal published.</td>
</tr>
<tr>
<td>1669</td>
<td>Nicholas Steno: Proposes that fossils are organic remains embedded in layers of sediment, basis of stratigraphy</td>
</tr>
<tr>
<td>1675</td>
<td>Anton van Leeuwenhoek: Observes Microorganisms by Microscope</td>
</tr>
<tr>
<td>1675</td>
<td>Leibniz developed Infinitesimal calculus and its widely used mathematical notation. Later he presented the theory of Monads and developed the Binary number system which is elemental for modern digital computing. His Law of Continuity and Transcendental Law of Homogeneity found mathematical implementation only in the 20th century.</td>
</tr>
<tr>
<td>1687</td>
<td>Newton: Laws of motion, law of universal gravitation, basis for classical physics</td>
</tr>
<tr>
<td>1735</td>
<td>Carl Linnaeus published the first edition of his major work Systema Naturae. The tenth edition of this book is considered the starting point of zoological nomenclature. In 1753 he published Species Plantarum which is the primary starting point of plant nomenclature as it exists today.</td>
</tr>
<tr>
<td>1763</td>
<td>Bayes' theorem named for Thomas Bayes who first suggested using the theorem to update beliefs was significantly edited and updated by Richard Price after the death of Thomas Bayes and read at the Royal</td>
</tr>
</tbody>
</table>
Society. This would later serve as foundation of Bayesian inference in statistics

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1767</td>
<td>James Denham-Steuart: used the term supply and demand in his on economics in <em>Inquiry into the Principles of Political economy</em>, published in 1767. Later, Adam Smith used it in his 1776 book <em>The Wealth of Nations</em>, and David Ricardo titled one chapter of his 1817 work <em>Principles of Political Economy and Taxation</em> &quot;On the Influence of Demand and Supply on Price&quot;.</td>
</tr>
<tr>
<td>1778</td>
<td>Antoine Lavoisier (and Joseph Priestley): discovery of oxygen leading to end of Phlogiston theory</td>
</tr>
<tr>
<td>1796</td>
<td>Georges Cuvier: Establishes extinction as a fact</td>
</tr>
<tr>
<td>1800</td>
<td>Alessandro Volta: discovers electrochemical series and invents the battery</td>
</tr>
<tr>
<td>1805</td>
<td>John Dalton: Atomic Theory in (Chemistry)</td>
</tr>
<tr>
<td>1859</td>
<td>Charles Darwin published his theory with compelling evidence for evolution in his book <em>On the Origin of Species</em></td>
</tr>
<tr>
<td>1866</td>
<td>Gregor Mendel published his work which demonstrated that the inheritance of certain traits in pea plants follows particular patterns, now referred to as the laws of Mendelian inheritance.</td>
</tr>
<tr>
<td>1869</td>
<td>Dmitri Mendeleev: Periodic table</td>
</tr>
<tr>
<td>1877</td>
<td>Ludwig Boltzmann: Statistical definition of entropy</td>
</tr>
<tr>
<td>1887</td>
<td>Michelson–Morley experiment was performed in 1887 by Albert A. Michelson and Edward W. Morley to detect the relative motion of matter through the stationary luminiferous aether (&quot;aether wind&quot;).</td>
</tr>
<tr>
<td>1890s</td>
<td>Santiago Ramón y Cajal discovered the axonal growth cone, and provided the definitive evidence for what would later be known as &quot;neuron theory&quot;, experimentally demonstrating that the relationship between nerve cells was not one of continuity, but rather of contiguity. &quot;Neuron theory&quot; stands as the foundation of modern neuroscience.</td>
</tr>
<tr>
<td>1899–1900</td>
<td>Sigmund Freud developed his theory of the unconscious mind and began his works on psychodynamic theory and psychosexual development of human organism. He proposed that human thought and behavior is complex process of unconscious processes in the mind</td>
</tr>
<tr>
<td>1900</td>
<td>Max Planck: Planck's law of black body radiation, basis for quantum theory</td>
</tr>
<tr>
<td>1905</td>
<td>Albert Einstein: theory of special relativity, explanation of Brownian motion, and photoelectric effect</td>
</tr>
<tr>
<td>1906</td>
<td>Walther Nernst: Third law of thermodynamics</td>
</tr>
<tr>
<td>1911</td>
<td>Ernest Rutherford: Atomic nucleus</td>
</tr>
<tr>
<td>1911</td>
<td>Oskar Heinroth rediscovered the phenomenon of psychological Imprinting, reported by Douglas Spalding in 1877. It was extensively worked on in the 20th century by Nikolaas Tinbergen, Karl von Frisch and Konrad Lorenz who demonstrated a &quot;critical period&quot; and other aspects concerning organization and elicitation of individual and social behaviour patterns in animals, earning them a Nobel prize in 1973.</td>
</tr>
<tr>
<td>1915</td>
<td>Albert Einstein: theory of general relativity</td>
</tr>
<tr>
<td>1924</td>
<td>Wolfgang Pauli: quantum Pauli exclusion principle</td>
</tr>
<tr>
<td>1925</td>
<td>– Erwin Schrödinger: Schrödinger equation (Quantum mechanics)</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
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<td>------</td>
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</tr>
<tr>
<td>1927</td>
<td>Werner Heisenberg: Uncertainty principle (Quantum mechanics)</td>
</tr>
<tr>
<td>1927</td>
<td>Georges Lemaître: Theory of the Big Bang</td>
</tr>
<tr>
<td>1928</td>
<td>Paul Dirac: Dirac equation (Quantum mechanics)</td>
</tr>
<tr>
<td>1929</td>
<td>Edwin Hubble: Hubble's law of the expanding universe</td>
</tr>
<tr>
<td>1930s</td>
<td>Keynes introduced Keynesian revolution, overturning neoclassical economics that held free markets would, in the short to medium term, automatically provide full employment, as long as workers were flexible in their wage demands. Keynes instead argued that aggregate demand determined the overall level of economic activity, and that inadequate aggregate demand could lead to prolonged periods of high unemployment.</td>
</tr>
<tr>
<td>1931</td>
<td>Friedrich Hayek elaborated the &quot;Austrian Theory of the Business Cycle&quot;. He argued that the business cycle resulted from the central bank's inflationary credit expansion and its transmission over time, leading to a capital misallocation caused by the artificially low interest rates.</td>
</tr>
<tr>
<td>1931</td>
<td>Kurt Gödel stated the incompleteness theorem which states that for any self-consistent recursive axiomatic system powerful enough to describe the arithmetic of the natural numbers (for example Peano arithmetic), there are true propositions about the naturals that cannot be proved from the axioms.</td>
</tr>
<tr>
<td>1934</td>
<td>James Chadwick: Discovery of the neutron</td>
</tr>
<tr>
<td>1934</td>
<td>Karl Popper emphasized the idea of falsifiability as the criterion demarcating science from non-science.</td>
</tr>
<tr>
<td>1937</td>
<td>Alan Turing: Introduced the mathematical concept of a Turing machine</td>
</tr>
<tr>
<td>1937</td>
<td>Kurt Lewin: on the basis of Herbert Blumer's interactionist perspective, suggested that neither nature (inborn tendencies) nor nurture (how experiences in life shape individuals) alone can account for individuals' behavior and personalities, but rather that both nature and nurture interact to shape each person. This is expressed as Lewin's Equation for behavior B=f(P,E). Earlier he coined the notion of genidentity,</td>
</tr>
<tr>
<td>1940s</td>
<td>Benjamin Lee Whorf brought focus to the Principle of linguistic relativity which implies that the structure of a language affects the weltanschauung or worldview of the speakers of the language and their cognition of the world. Whorf's works tried to show that there is relationship between language and thought. The idea was introduced earlier by Humboldt and then worked on by Edward Sapir in the 1920s.</td>
</tr>
<tr>
<td>1942</td>
<td>Joseph Schumpeter introduced the idea creative destruction, sometimes known as &quot;Schumpeter's gale&quot; in his work <em>Capitalism, Socialism and Democracy</em> (1942), where in he described the way in which capitalist economic development arises out of the destruction of some prior economic order.</td>
</tr>
<tr>
<td>1943</td>
<td>Oswald Avery proves that DNA is the genetic material of the chromosome</td>
</tr>
<tr>
<td>1943</td>
<td>Walter Pitts and Warren McCulloch wrote the seminal paper entitled &quot;A Logical Calculus of Ideas Immanent in Nervous Activity&quot; (1943) and proposed the first mathematical model of a neural network. Their work also presented ideas drawn upon the work of Leibniz with later implications for cellular automata.</td>
</tr>
<tr>
<td>1944</td>
<td>John von Neumann and Stanislaw Ulam: introduced the mathematical idea of a cellular automata. This set the foundations for the later discipline of complexity science and agent based modeling</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
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</tr>
<tr>
<td>1944</td>
<td>John von Neumann and Oskar Morgenstern: wrote the seminal book <em>Theory of games and economic behavior</em> and began the interdisciplinary research field of game theory</td>
</tr>
<tr>
<td>1947</td>
<td>William Shockley, John Bardeen and Walter Brattain invent the first transistor</td>
</tr>
<tr>
<td>1948</td>
<td>Claude Elwood Shannon &amp; Warren Weaver: 'A mathematical theory of communication' a seminal paper in Information theory.</td>
</tr>
<tr>
<td>1948</td>
<td>Norbert Wiener: introduced the concept of Cybernetics in his work <em>Cybernetics: Or the Control and Communication in the Animal and the Machine.</em></td>
</tr>
<tr>
<td>1948</td>
<td>Richard Feynman, Julian Schwinger, Sin-Itiro Tomonaga and Freeman Dyson: Quantum electrodynamics</td>
</tr>
<tr>
<td>1950</td>
<td>Ludwig von Bertalanffy began General systems theory with his publication &quot;An Outline of General System Theory&quot; in the British Journal for the Philosophy of Science Vol. 1 (No. 2)</td>
</tr>
<tr>
<td>1950s</td>
<td>Kenneth Arrow, Gérard Debreu and Lionel W. McKenzie introduced the modern conception of general equilibrium in economics. Gerard Debreu presents this model in Theory of Value (1959). Though an earlier form of general equilibrium was presented by Leon Walras in 1874.</td>
</tr>
<tr>
<td>1950s</td>
<td>Leon Festinger developed the Theory of Cognitive Dissonance and Social Comparison Theory, and discovered nature of the role of propinquity in the formation of social ties while also making other contributions to the study of social networks, psychological social psychology and sociological social psychology.</td>
</tr>
<tr>
<td>1951</td>
<td>John Bowlby developed attachment theory which states that human individuals, especially as children, needs to develop a stable and long lasting relationship with at least one primary caregiver for social and emotional development to occur normally. Relationships later in life are built on this primary foundation. The theory states that in human evolution, attachment behaviour increased the chances of survival.</td>
</tr>
<tr>
<td>1952</td>
<td>Jonas Salk: developed and tested first polio vaccine</td>
</tr>
<tr>
<td>1953</td>
<td>Crick and Watson: helical structure of DNA, basis for molecular biology</td>
</tr>
<tr>
<td>1953</td>
<td>Anatol Rapoport introduced mathematical models in the study of information transmission in human interaction and for the management of conflict and cooperation in human life</td>
</tr>
<tr>
<td>1953</td>
<td>Ludwig Wittgenstein: wrote his seminal work Philosophical Investigations in which he stated that conceptual confusions surrounding language use are at the root of most philosophical problems.</td>
</tr>
<tr>
<td>1954</td>
<td>Jean Piaget: elaborated on Genetic epistemology and the theory of cognitive development in his work &quot;La construction du réel chez l'enfant&quot; (The construction of reality in the child).</td>
</tr>
<tr>
<td>1956</td>
<td>Frank Harary and Dorwin Cartwright mathematically formalized generalizations of Fritz Heider's psychological theory of cognitive balance to give formalization of interpersonal network patterns. This laid the foundations for micro level social network analysis and small group research and group dynamics research in sociology and sociological social psychology</td>
</tr>
<tr>
<td>1957</td>
<td>Noam Chomsky: wrote Syntactic Structures which laid the foundation for the idea of transformational grammar. He also introduced the idea of poverty of the stimulus which states that natural language grammar is unlearnable given the relatively limited data available to children learning a language, and therefore that this knowledge is supplemented with some sort of innate linguistic capacity.</td>
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<tr>
<td>Year</td>
<td>Event</td>
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<tr>
<td>1957</td>
<td>Herbert Simon: coined the term Bounded rationality in psychology as an alternative basis for the mathematical modeling of decision making, as used in economics and related disciplines which views rationality as a <em>maximization</em> process as described in rational choice theory. Instead, &quot;bounded rationality&quot; views rationality as a <em>Satisficing</em> process. He was awarded the Nobel Prize in 1978.</td>
</tr>
<tr>
<td>1958</td>
<td>William Phillips, introduced Phillips curve in economic theory. He described the observation of an inverse relationship between money wage changes and unemployment in the British economy over the period examined. In 1960 Paul Samuelson and Robert Solow took Phillips' work and made explicit the link between inflation and unemployment: when inflation was high, unemployment was low, and vice versa.</td>
</tr>
<tr>
<td>1960s</td>
<td>Paul Ekman conducted seminal research on the specific biological correlates of specific emotions, demonstrating the universality and discreteness of emotions in a Darwinian approach. This served as one of the basis for E. O. Wilson's works on Sociobiology in the 1970s and later helped in the emergence of the approach of Evolutionary Psychology in the 1990s through the work of Leda Cosmides and John Tooby.</td>
</tr>
<tr>
<td>1962</td>
<td>Thomas Kuhn stated that scientific fields undergo periodic &quot;paradigm shifts&quot; rather than solely progressing in continuous way; which open up new approaches to understanding that scientists would never have considered valid before; and that the notion of scientific truth, at any given moment, cannot be established solely by objective criteria but is defined by a consensus of a scientific community.</td>
</tr>
<tr>
<td>1963</td>
<td>Stanley Milgram first published a series of experiments now known as Milgram experiment which demonstrated how people showed obedience to orders in a social system when the orders were given by authority figures even when people were asked to perform actions against their wish and conscience. The studies were done in order to explain conformity and obedience in society as seen during the Holocaust.</td>
</tr>
<tr>
<td>1963</td>
<td>Lawrence Morley, Fred Vine, and Drummond Matthews: Paleomagnetic stripes in ocean crust as evidence of plate tectonics (Vine–Matthews–Morley hypothesis).</td>
</tr>
<tr>
<td>1964</td>
<td>Murray Gell-Mann and George Zweig: postulate quarks leading to the standard model.</td>
</tr>
<tr>
<td>1968</td>
<td>Robert Rosenthal and Lenore Jacobson 1968 experimentally demonstrated Self fulfilling prophecy in social relationships through their field experiment which showed that if teachers were led to expect enhanced performance from some children, then those children did indeed show that enhancement. This is also known as Late bloomers effect.</td>
</tr>
<tr>
<td>1968–1970</td>
<td>Terry Winograd made the artificial intelligence and natural language processing program SHRDLU that was concerned with the problem of providing a computer with sufficient &quot;understanding&quot; to be able to use natural language.</td>
</tr>
<tr>
<td>1969</td>
<td>German computer pioneer Konrad Zuse published his book <em>Calculating Space</em>, proposing that the physical laws of the universe are discrete by nature, and that the entire universe is the output of a deterministic computation on a single cellular automaton; &quot;Zuse's Theory&quot; became the foundation of the</td>
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<tr>
<td>Year</td>
<td>Event</td>
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<td>------</td>
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<tr>
<td>1969</td>
<td>The invention of the Internet.</td>
</tr>
<tr>
<td>1970</td>
<td>George Akerlof elaborated the idea of economic activity under asymmetric information. He described information asymmetry, which occurs when the seller knows more about a product than the buyer. Later, Akerlof, Michael Spence, and Joseph Stiglitz jointly received the Nobel Memorial Prize in Economic Sciences in 2001 for their work on economic behavior under asymmetric information.</td>
</tr>
<tr>
<td>1970</td>
<td>John Horton Conway made the computer program Game of Life, also known simply as Life, a cellular automaton in which its evolution is determined by its initial state, requiring no further input. The game of life simulates the rise, fall and alterations of a society of living organisms.</td>
</tr>
<tr>
<td>1970s</td>
<td>Amos Tversky and Daniel Kahneman published series of discoveries on the psychology of human judgment and decision making describing the pervasive nature of systematic human cognitive bias and handling of risk in everyday life.</td>
</tr>
<tr>
<td>1972</td>
<td>Paleontologists Niles Eldredge and Stephen Jay Gould published a landmark paper developing this theory and called it punctuated equilibria.</td>
</tr>
<tr>
<td>1972</td>
<td>Michael D. Cohen, James G. March and Johan Olsen proposed the Garbage can model of organizational decision making. They published the model along with a computer code. Earlier James G. March presented the Behavioral theory of the firm in 1963 and made a compendium of basic Organizational studies, Management science, and organizational behavior in his edition &quot;A Handbook of Organizations&quot; (1965).</td>
</tr>
<tr>
<td>1973</td>
<td>Mark Granovetter published his seminal work in modern sociology and social network theory on the spread of information in social networks known as &quot;The Strength of Weak Ties&quot; describing how weak ties enable reaching populations and audiences that are not accessible via strong ties.</td>
</tr>
<tr>
<td>1977</td>
<td>Voyager program launched two unmanned space missions, the probes Voyager 1 and Voyager 2 to study planetary systems.</td>
</tr>
<tr>
<td>1981–1984</td>
<td>Robert Axelrod and W. D. Hamilton described the evolution of cooperation between cognitive entities and gave a mathematical and computational model describing the phenomena.</td>
</tr>
<tr>
<td>1986</td>
<td>David Rumelhart and James McClelland described the idea of Parallel Distributed Processing in modeling human cognition in psychology. They made mathematical and computational models of psychological information processing and described computer simulations of perception, giving testable models of neural information processing and introducing Connectionism.</td>
</tr>
<tr>
<td>1987</td>
<td>John C. Turner and Michael Hogg along with other colleagues developed the Self categorization theory which gives a psychological theory for dynamics in group processes. It states that the self is not the foundational aspect of cognition, rather the self is a product of cognitive processes that occur in social processes. Earlier John Turner worked with Henri Tajfel (1979) on the precursor theory Social identity theory.</td>
</tr>
<tr>
<td>1988</td>
<td>The concept of a Quantum cellular automata was introduced thus advancing quantum computation and quantum computer.</td>
</tr>
<tr>
<td>Year(s)</td>
<td>Event/Invention/Discovery</td>
</tr>
<tr>
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<tr>
<td>1970s–1988</td>
<td>Marvin Minsky &amp; Seymour Papert started developing what came to be called The Society of Mind theory. They state how intelligence could be a product of the interaction of non-intelligent parts. Minsky says that the biggest source of ideas about the theory came from his work in trying to create a machine that uses a robotic arm, a video camera, and a computer to build with children's blocks.</td>
</tr>
<tr>
<td>1988</td>
<td>Luigi Luca Cavalli-Sforza reconstructed human evolution and migration patterns in human history in his work in population genetics. He claimed to show a strong association between language families and genetic trees of the same populations, proposing for genetic–linguistic coevolution.</td>
</tr>
<tr>
<td>1996</td>
<td>Joshua M. Epstein along with Robert Axtell developed the first large scale agent-based computational model, the Sugarscape, to explore the role of social phenomenon such as seasonal migrations, pollution, sexual reproduction, combat, and transmission of disease and even culture. With this work Epstein laid the foundation for what he later called as Generative social science.</td>
</tr>
<tr>
<td>1997</td>
<td>Roslin Institute: Dolly the sheep was cloned.</td>
</tr>
<tr>
<td>1998</td>
<td>Gerson Goldhaber and Saul Perlmutter observed that the expansion of the universe is accelerating.</td>
</tr>
<tr>
<td>2000</td>
<td>Alison Gopnik and Andrew N. Meltzoff and Patricia K. Kuhl stated that the same mechanisms used by scientists to develop scientific theories are used by children to develop causal models of their environment. They state that the cognitive development of children in early life is made possible by three factors: innate knowledge, advanced learning ability, and the evolved ability of parents to teach their offspring.</td>
</tr>
<tr>
<td>2001</td>
<td>The first draft of the human genome is completed.</td>
</tr>
<tr>
<td>2002</td>
<td>Daniel Wegner published his book stating that the experience of free will is an illusion. Wegner conducted a series of experiments in which people experience an illusion of control, feeling that their free will shapes events when actually it were determined by someone else. According to Wegner the fact that this illusion of free will can be created shows that it is an illusion and that it is &quot;the mind's best trick&quot;.</td>
</tr>
<tr>
<td>2009</td>
<td>The Max Planck Institute for Evolutionary Anthropology and Life Sciences Corporation completed making a draft sequencing of the genome of the closest human relative the Neanderthal.</td>
</tr>
<tr>
<td>2010</td>
<td>J. Craig Venter Institute creates the first synthetic bacterial cell.</td>
</tr>
<tr>
<td>2011</td>
<td>A team led by Shinji Nishimoto made break through in Thought identification when they partially...</td>
</tr>
</tbody>
</table>
reconstructed visual images from only brain recordings of neural activity of volunteers who were seeing actual visual pictures or images.

2012  Higgs Boson is discovered at CERN (confirmed to 99.999% certainty)

Timeline of Roman history

8th and 7th centuries BC

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>753 BC</td>
<td>21 April</td>
<td>Rome was founded. According to Roman legend, Romulus was the founder and first King of Rome, establishing the Roman Kingdom.</td>
</tr>
<tr>
<td>715 BC</td>
<td></td>
<td>Numa Pompilius became the second King of Rome.</td>
</tr>
<tr>
<td>673 BC</td>
<td></td>
<td>Tullus Hostilius became the third King of Rome.</td>
</tr>
<tr>
<td>667 BC</td>
<td></td>
<td>Byzantium was founded by Megarian colonists.</td>
</tr>
<tr>
<td>642 BC</td>
<td></td>
<td>Tullus Hostilius died.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Curiate Assembly, one of the legislative assemblies of the Roman Kingdom, elected Ancus Marcius King of Rome.</td>
</tr>
<tr>
<td>617 BC</td>
<td></td>
<td>Ancus Marcius died.</td>
</tr>
<tr>
<td>616 BC</td>
<td></td>
<td>The Curiate Assembly elected Lucius Tarquinius Priscus King of Rome.</td>
</tr>
</tbody>
</table>

6th century BC

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>575 BC</td>
<td></td>
<td>The Senate accepted the regent Servius Tullius as king of Rome.</td>
</tr>
<tr>
<td>535 BC</td>
<td></td>
<td>Servius Tullius was murdered by his daughter Tullia Minor and her husband Lucius Tarquinius Superbus, who declared himself King of Rome on the steps of the Curia Hostilia.</td>
</tr>
<tr>
<td>509 BC</td>
<td></td>
<td>The patrician Lucretia was raped by Lucius Tarquinius Superbus' son Sextus Tarquinius.</td>
</tr>
</tbody>
</table>
Overthrow of the Roman monarchy: Following Lucretia's suicide, Lucius Junius Brutus called the Curiate Assembly, one of the legislative assemblies of the Roman Kingdom. The latter agreed to the overthrow and expulsion of Lucius Tarquinius Superbus and to a provisional constitution under which two consuls acted as a joint executive and a Curiate Assembly held legislative power, and swore never again to let a king rule Rome. It further elected Lucius Junius Brutus and Lucius Tarquinius Collatinus, Lucretia's husband, as consuls.

Battle of Silva Arsia: Tarquinian and Veientine forces loyal to Lucius Tarquinius Superbus were defeated in the Silva Arsia by a Roman army. Lucius Junius Brutus was killed. Publius Valerius Publicola, returning to Rome with the spoils of war, was awarded the first Roman Triumph on March 1.

The consul Publius Valerius Publicola promulgated a number of liberal reforms, including opening the office of consul to all Roman citizens and placing the treasury under the administration of appointed quaestors.

13 September The Temple of Jupiter Optimus Maximus was ceremonially dedicated to the Capitoline Triad.


501 BC In the face of a potential Sabine invasion, the Senate passed a *senatus consultum* authorizing the consuls to appoint a dictator, a magistrate who held absolute power during a national emergency. The dictator would in turn appoint the *Magister equitum*, the commander of the cavalry. The consuls Titus Lartius and Postumus Cominius Auruncus selected the former as dictator.

5th century BC

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>496 BC</td>
<td></td>
<td><em>Battle of Lake Regillus</em>: Latin League invasion near modern Frascati which sought to reinstall Lucius Tarquinius Superbus.</td>
</tr>
<tr>
<td>494 BC</td>
<td></td>
<td><em>First secessio plebis</em>:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lucius Sicinius Vellutus, the <em>plebs</em> abandoned Rome for the nearby Monte Sacro.</td>
</tr>
<tr>
<td>471 BC</td>
<td></td>
<td>After a law allowing organization of the <em>plebs</em> tribe, the Plebeian Council was reorganized by tribes</td>
</tr>
</tbody>
</table>
rather than curiae.

459 BC  Under popular pressure, the Senate increased the tribunes of the plebs from two to ten.

458 BC  During the first dictatorship of Cincinnatus, the Aequians staged an offensive, breaking a truce. Cincinnatus defeated the Aquians at the Battle of Mount Algidus and after a triumph, returned to his farm after sixteen days.

449 BC  Resolutions of the Plebeian Council were given the full force of law subject to Senate veto.

448 BC  The second of two decemviri, specially-elected ten man commissions, issued the last of the Twelve Tables, the fundamental laws of the Republic.

447 BC  The Tribal Assembly was established, and granted the right to elect quaestors.

445 BC  Lex Canuleia: Marriage between patricians and plebeians was legalized.

443 BC  The offices of the Tribuni militum consulari potestate were established. A collegium of three patrician or plebeian tribunes, one each from specific Roman tribes (the Titienses, the Ramnenses, and the Luceres), would hold the power of the consuls from year to year, subject to the Senate.

439 BC  Cincinnatus was called upon to accept a second dictatorship by the patricians to prevent Spurius Maelius from seizing power; the patricians suspected Spurius of using wheat to purchase the support of the plebeians, to set himself up as a king. Gaius Servilius Ahala was appointed magister equitum in order to stop Maelius; following an attack by Maelius, Ahala slew him. Cincinnatus again resigned his dictatorship and returned to his farm after 21 days.

435 BC  Fidenae, an important trade post on the Tiber, was captured from the Veii.

408 BC  The Tribuni militum consulari potestate held office.

4th century BC

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>396 BC</td>
<td></td>
<td>Battle of Veii: Roman forces led by the dictator Marcus Furius Camillus conquered Veii.</td>
</tr>
<tr>
<td>396 BC</td>
<td></td>
<td>Roman soldiers first earned a salary (&quot;salary&quot; from Latin for &quot;salt&quot;).</td>
</tr>
<tr>
<td>394 BC</td>
<td></td>
<td>The consuls held office.</td>
</tr>
<tr>
<td>391 BC</td>
<td></td>
<td>The Tribuni militum consulari potestate held office.</td>
</tr>
<tr>
<td>390 BC</td>
<td>18 July</td>
<td>Battle of the Allia: The Senones routed a Roman force at the confluence of the rivers Allia and Tiber.</td>
</tr>
</tbody>
</table>
The Senones sacked Rome. Among other artifacts, books were destroyed. The history of Rome up to this point had to be mostly reconstructed and is sometimes unreliable or mythological.

<table>
<thead>
<tr>
<th>Year</th>
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</tr>
</thead>
<tbody>
<tr>
<td>367 BC</td>
<td>The consuls held office.</td>
</tr>
<tr>
<td>366 BC</td>
<td>Lucius Sextius was elected the first plebeian consul.</td>
</tr>
<tr>
<td></td>
<td>The office of <em>Praetor</em>, which took the judiciary responsibilities of the consul and could be held only by a patrician, was established.</td>
</tr>
<tr>
<td>351 BC</td>
<td>The first plebeian dictator was elected.</td>
</tr>
<tr>
<td></td>
<td>The first plebeian censor was elected.</td>
</tr>
<tr>
<td>343 BC</td>
<td><em>Samnite Wars</em>: Rome marched against the Samnites, probably after an appeal from the Campanians.</td>
</tr>
<tr>
<td></td>
<td><em>Battle of Mount Gaurus</em>: A Samnite force was routed by a Roman army near Mount Barbaro.</td>
</tr>
<tr>
<td>342 BC</td>
<td>The <em>Leges Genuciae</em> were passed, banning a person from holding two offices at the same time, or during any ten-year period; charging interest on loans was also banned.</td>
</tr>
<tr>
<td>341 BC</td>
<td><em>Samnite Wars</em>: The Senate agreed a peace, following an appeal by the Samnite to a previous treaty of friendship.</td>
</tr>
<tr>
<td>339 BC</td>
<td>A law was passed which required the election of at least one plebeian censor every five years.</td>
</tr>
<tr>
<td>338 BC</td>
<td><em>Latin War</em>: Rome defeated the Latin League armies.</td>
</tr>
<tr>
<td>337 BC</td>
<td>The first plebeian <em>Praetor</em> was elected.</td>
</tr>
<tr>
<td>328 BC</td>
<td><em>Samnite Wars</em>: Rome declared war on the Samnites after their failure to prevent their subjects raiding Fregellae.</td>
</tr>
<tr>
<td>321 BC</td>
<td><em>Battle of the Caudine Forks</em>: After being trapped in a mountain pass near Caudium without a water supply, Roman forces were allowed to retreat by a Samnite army.</td>
</tr>
<tr>
<td>315 BC</td>
<td><em>Battle of Lautulae</em>: A decisive Samnite victory near Terracina split Roman territory in two.</td>
</tr>
<tr>
<td>311 BC</td>
<td><em>Samnite Wars</em>: The Etruscans laid siege to Sutri.</td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
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<td>------</td>
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</tr>
<tr>
<td>310 BC</td>
<td>Battle of Lake Vadimo (310 BC): Rome inflicted a substantial military defeat on the Etruscans at Lake Vadimo.</td>
</tr>
<tr>
<td>308 BC</td>
<td>Samnite Wars: The Umbri, Picentes and Marsi joined the Samnites against Rome.</td>
</tr>
<tr>
<td>306 BC</td>
<td>The Hernici declared their independence from Rome.</td>
</tr>
<tr>
<td>304 BC</td>
<td>Rome conquered the Aequi.</td>
</tr>
<tr>
<td>3rd century BC</td>
<td>Samnite Wars: The treaty of friendship between the Romans and Samnites was restored.</td>
</tr>
</tbody>
</table>

### 3rd century BC

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>300 BC</td>
<td>The Lex Ogulnia was passed, allowing plebeians to become priests.</td>
<td></td>
</tr>
<tr>
<td>298 BC</td>
<td>Samnite Wars: Rome declared war on the Samnites after an appeal by the Lucani.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Samnite Wars: Rome captured the Samnite cities of Bojano and Castel di Sangro.</td>
<td></td>
</tr>
<tr>
<td>297 BC</td>
<td>Battle of Tifernum: A Roman army defeated a numerically superior Samnite force at Città di Castello.</td>
<td></td>
</tr>
<tr>
<td>295 BC</td>
<td>Battle of Sentinum: A Roman army decisively defeated a numerically superior force of Samnites, Etruscans, Umbri and Senones in coalition at Sentinum. The consul Publius Decius Mus (consul 312 BC) was killed.</td>
<td></td>
</tr>
<tr>
<td>294 BC</td>
<td>Samnite Wars: Roman and Samnite forces battled at Lucera.</td>
<td></td>
</tr>
<tr>
<td>293 BC</td>
<td>Battle of Aquilonia: A Roman army destroyed the majority of Samnite forces, probably in modern Agnone.</td>
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<tr>
<td></td>
<td>A census counted about 270,000 residents of Rome.</td>
<td></td>
</tr>
<tr>
<td>291 BC</td>
<td>Samnite Wars: Rome conquered and colonized the Samnite city of Venosa.</td>
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</tr>
<tr>
<td>290 BC</td>
<td>Samnite Wars: The last effective Samnite resistance was eliminated.</td>
<td></td>
</tr>
<tr>
<td>287 BC</td>
<td>Conflict of the Orders: A secessio plebis took place.</td>
<td></td>
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<tr>
<td>Year</td>
<td>Event</td>
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</tr>
<tr>
<td>283 BC</td>
<td><em>Battle of Lake Vadimo (283 BC):</em> A Roman army defeated a combined force of Etruscans, Boi and Senones near Lake Vadimo.</td>
<td></td>
</tr>
<tr>
<td>281 BC</td>
<td>Taranto appealed to Epirus for aid against Rome.</td>
<td></td>
</tr>
<tr>
<td>280 BC</td>
<td><em>Pyrrhic War:</em> An Epirote army of some 25,000 landed at Taranto.</td>
<td></td>
</tr>
<tr>
<td>279 BC</td>
<td><em>Battle of Asculum:</em> A Greek force led by the Epirote king Pyrrhus of Epirus defeated a Roman army at modern Ascoli Satriano, despite suffering heavy losses.</td>
<td></td>
</tr>
<tr>
<td>275 BC</td>
<td><em>Battle of Beneventum (275 BC):</em> Roman and Epirote armies met in a bloody battle at Benevento.</td>
<td></td>
</tr>
<tr>
<td>272 BC</td>
<td><em>Pyrrhic War:</em> Pyrrhus withdrew with his army to Epirus.</td>
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</tr>
<tr>
<td>267 BC</td>
<td>The number of quaestors was raised from four to ten.</td>
<td></td>
</tr>
<tr>
<td>264 BC</td>
<td><em>Battle of Messana:</em> A Roman force defeated a Carthaginian and Siracusani garrison at Messina.</td>
<td></td>
</tr>
<tr>
<td>242 BC</td>
<td>The office of the <em>praetor qui inter peregrinos ius dicit</em>, a <em>Praetor</em> with jurisdiction over foreigners, was created.</td>
<td></td>
</tr>
<tr>
<td>241 BC</td>
<td><em>First Punic War:</em> Sicily was organized as the province of Sicilia.</td>
<td></td>
</tr>
<tr>
<td>238 BC</td>
<td><em>Mercenary War:</em> Carthage surrendered its claims on Sardinia and Corsica to Rome.</td>
<td></td>
</tr>
<tr>
<td>229 BC</td>
<td><em>Illyrian Wars:</em> Rome invaded the territory of the Ardiaei.</td>
<td></td>
</tr>
<tr>
<td>228 BC</td>
<td><em>Illyrian Wars:</em> The Ardiaei surrendered some territory, including strategically significant ports, to Rome, ending the war.</td>
<td></td>
</tr>
<tr>
<td>225 BC</td>
<td><em>Battle of Telamon:</em> A Roman army decisively defeated a Gallic invasion near modern Talamone. The consul Gaius Atilius Regulus was killed.</td>
<td></td>
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<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
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<tr>
<td>219 BC</td>
<td></td>
<td><em>Illyrian Wars</em>: Rome invaded Hvar.</td>
</tr>
<tr>
<td>218 BC</td>
<td></td>
<td><em>Second Punic War</em>: A Carthaginian army departed Cartagena.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Illyrian Wars</em>: Demetrius of Pharos fled to Macedonia.</td>
</tr>
<tr>
<td>216 BC</td>
<td>2 August</td>
<td><em>Battle of Cannae</em>: The Carthaginian general Hannibal decisively defeated a numerically superior Roman force at Cannae.</td>
</tr>
<tr>
<td>214 BC</td>
<td></td>
<td><em>First Macedonian War</em>: A Macedonian fleet captured Oricum.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Siege of Syracuse (214–212 BC)</em>: Rome laid siege to Syracuse.</td>
</tr>
<tr>
<td>212 BC</td>
<td></td>
<td><em>Siege of Syracuse (214–212 BC)</em>: Roman forces breached the inner citadel of Syracuse and slaughtered its inhabitants.</td>
</tr>
<tr>
<td>205 BC</td>
<td></td>
<td><em>First Macedonian War</em>: Rome and Macedonia signed the Treaty of Phoenice, according to which Macedonia renounced its alliance with Carthage in exchange for Roman recognition of its gains in Illyria.</td>
</tr>
<tr>
<td>204 BC</td>
<td></td>
<td><em>Second Punic War</em>: The consul Scipio Africanus landed an invasion fleet at Utica.</td>
</tr>
<tr>
<td>202 BC</td>
<td>19 October</td>
<td><em>Battle of Zama</em>: A Roman army decisively defeated Carthage, probably near modern Sakiet Sidi Youssef.</td>
</tr>
<tr>
<td>201 BC</td>
<td></td>
<td><em>Second Punic War</em>: Carthage accepted Roman conditions for peace, including disarmament, a war indemnity of ten thousand talents, and the cession of Iberia, ending the war.</td>
</tr>
</tbody>
</table>

2nd century BC

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>200 BC</td>
<td></td>
<td><em>Second Macedonian War</em>: A Roman fleet arrived in Illyria to relieve a Macedonian siege of Abydos.</td>
</tr>
<tr>
<td>197 BC</td>
<td></td>
<td>The provinces of Hispania Ulterior and Hispania Citerior were organized.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The number of quaestors was increased to twelve.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The number of <em>Praetors</em> was increased to six.</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
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</tr>
<tr>
<td>196 BC</td>
<td><em>Second Macedonian War:</em> Macedonia surrendered its conquests in Greece and agreed to pay a war indemnity, ending the war.</td>
<td></td>
</tr>
<tr>
<td>192 BC</td>
<td><em>Roman–Seleucid War:</em> The Seleucid Empire invaded Greece.</td>
<td></td>
</tr>
<tr>
<td>188 BC</td>
<td><em>Roman–Seleucid War:</em> The Seleucid Empire signed the Treaty of Apamea, under which it surrendered all territory west of the Taurus Mountains to the Roman clients Rhodes and Pergamon and agreed to disarm its navy and pay a war indemnity of fifteen thousand talents of silver to Rome.</td>
<td></td>
</tr>
<tr>
<td>180 BC</td>
<td>The <em>Lex Villia annalis</em>, which established minimum ages for high office and required a minimum of two years in private life between offices, was passed.</td>
<td></td>
</tr>
<tr>
<td>172 BC</td>
<td><em>Third Macedonian War:</em> Rome declared war on Macedonia.</td>
<td></td>
</tr>
<tr>
<td>167 BC</td>
<td><em>Third Macedonian War:</em> The Macedonian king Perseus of Macedon was captured. Macedonia was divided into four districts subject to Rome.</td>
<td></td>
</tr>
<tr>
<td>155 BC</td>
<td><em>Lusitanian War:</em> The Lusitanians of Hispania Ulterior rebelled against Rome.</td>
<td></td>
</tr>
<tr>
<td>150 BC</td>
<td><em>Fourth Macedonian War:</em> An Andriscus rebelled against Rome, claiming to be Perseus's son and the rightful king of Macedonia.</td>
<td></td>
</tr>
<tr>
<td>149 BC</td>
<td><em>Third Punic War:</em> Rome declared war on Carthage.</td>
<td></td>
</tr>
<tr>
<td>148 BC</td>
<td><em>Fourth Macedonian War:</em> Andriscus was surrendered to Rome to be executed.</td>
<td></td>
</tr>
<tr>
<td>146 BC</td>
<td><em>Third Punic War:</em> Roman forces breached the city of Carthage, burned it, and enslaved its surviving inhabitants.</td>
<td></td>
</tr>
<tr>
<td>146 BC</td>
<td><em>Achaean War:</em> Roman forces decisively defeated the armies of the Achaean League at Corinth.</td>
<td></td>
</tr>
<tr>
<td>139 BC</td>
<td><em>Lusitanian War:</em> The Lusitanian leader Viriatus was assassinated by his three ambassadors to</td>
<td></td>
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<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>133 BC</td>
<td>The Tribune of the Plebs Tiberius Gracchus was beaten to death by a mob of senators led by the Pontifex Maximus Publius Cornelius Scipio Nasica Serapio (consul 138 BC).</td>
<td></td>
</tr>
<tr>
<td>121 BC</td>
<td>The province of Gallia Narbonensis was organized.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The first Senatus consultum ultimum was passed, granting the consul Lucius Opimius emergency powers to defeat the partisans of Gaius Gracchus.</td>
<td></td>
</tr>
<tr>
<td>112 BC</td>
<td><em>Jugurthine War:</em> Rome declared war on Numidia.</td>
<td></td>
</tr>
<tr>
<td>107 BC</td>
<td>Gaius Marius was elected consul.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marius instituted the Marian reforms of the military, among them the establishment of a standing army and the recruitment of non-property owners.</td>
<td></td>
</tr>
<tr>
<td>106 BC</td>
<td>Marius was reelected consul.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Jugurthine War:</em> The Numidian king Jugurtha was imprisoned in the Mamertine Prison.</td>
<td></td>
</tr>
<tr>
<td>105 BC</td>
<td>6 October</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Battle of Arausio:</em> A coalition of the Cimbri and Teutons inflicted a serious defeat on the Roman army at modern Orange. Some hundred thousand Roman soldiers were killed.</td>
<td></td>
</tr>
<tr>
<td>104 BC</td>
<td>Marius was elected consul for the first of three years in a row.</td>
<td></td>
</tr>
<tr>
<td>102 BC</td>
<td><em>Battle of Aquae Sextiae:</em> Rome decisively defeated the forces of the Teutons and Ambrones and killed some ninety thousand soldiers and civilians.</td>
<td></td>
</tr>
<tr>
<td>101 BC</td>
<td><em>Battle of Vercellae:</em> An invasion of Italy by the Cimbri was decisively defeated by a numerically inferior Roman force. Some hundred thousand Cimbri soldiers and civilians were killed along with their king Boiorix.</td>
<td></td>
</tr>
</tbody>
</table>

1st century BC
<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>100 BC</td>
<td></td>
<td>Marius was elected consul.</td>
</tr>
<tr>
<td>10 December</td>
<td></td>
<td>Assassins hired by Marius's political allies Lucius Appuleius Saturninus and Gaius Servilius Glaucia beat to death Gaius Memmius, a candidate for the consulship.</td>
</tr>
<tr>
<td>91 BC</td>
<td></td>
<td>Social War (91–88 BC): The Roman clients in Italy the Marsi, the Paeligni, the Vestini, the Marrucini, the Picentes, the Frentani, the Hirpini, the Iapyges, Pompeii, Venosa, Lucania and Samnium rebelled against Rome.</td>
</tr>
<tr>
<td>88 BC</td>
<td></td>
<td>Sulla's first civil war: The consul Sulla led an army of his partisans across the pomerium into Rome.</td>
</tr>
<tr>
<td>87 BC</td>
<td></td>
<td>First Mithridatic War: Roman forces landed at Epirus.</td>
</tr>
<tr>
<td>85 BC</td>
<td></td>
<td>First Mithridatic War: A peace was agreed between Rome and Pontus under which the latter returned to its prewar borders.</td>
</tr>
<tr>
<td>83 BC</td>
<td></td>
<td>Sulla's second civil war: Sulla landed with an army at Brindisi.</td>
</tr>
<tr>
<td>82 BC</td>
<td></td>
<td>Second Mithridatic War: The Roman general Lucius Licinius Murena invaded Pontus.</td>
</tr>
<tr>
<td>81 BC</td>
<td></td>
<td>Sulla's second civil war: Sulla was declared dictator.</td>
</tr>
<tr>
<td>80 BC</td>
<td></td>
<td>Second Mithridatic War: Murena withdrew from Pontus.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sulla resigns dictatorship after enacting numerous reforms in the same year.</td>
</tr>
<tr>
<td>80 BC</td>
<td></td>
<td>Final consulship of Sulla, he leaves Rome once the year is over.</td>
</tr>
<tr>
<td>73 BC</td>
<td></td>
<td>Third Mithridatic War: Pontus invaded Bithynia.</td>
</tr>
<tr>
<td>73 BC</td>
<td></td>
<td>Third Servile War: Some seventy gladiators, slaves of Lentulus Batiatus in Capua, made a violent escape.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>72 BC</td>
<td><strong>Sertorian War</strong>: Marcus Perpenna Vento, by now the leader of the Romans in revolt in Iberia, was executed by the general Pompey.</td>
<td></td>
</tr>
<tr>
<td>71 BC</td>
<td><strong>Third Servile War</strong>: The slaves in rebellion were decisively defeated by Roman forces near Petelia. Their leader Spartacus was killed.</td>
<td></td>
</tr>
<tr>
<td>66 BC</td>
<td>The last of the Cilician pirates were wiped out by Pompey.</td>
<td></td>
</tr>
<tr>
<td>63 BC</td>
<td><strong>Third Mithridatic War</strong>: Defeated, the Pontic king Mithridates VI of Pontus ordered his friend and bodyguard to kill him.</td>
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</tr>
<tr>
<td></td>
<td><strong>Siege of Jerusalem (63 BC)</strong>: Pompey conquered Jerusalem and entered the Holy of Holies of the Second Temple.</td>
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<tr>
<td></td>
<td>Cicero was elected consul.</td>
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<tr>
<td></td>
<td><strong>Second Catilinarian conspiracy</strong>: A conspiracy led by the senator Catiline to overthrow the Republic was exposed before the Senate. The five conspirators present were summarily executed in the Mamertine Prison.</td>
<td></td>
</tr>
<tr>
<td>60 BC</td>
<td>Pompey joined a political alliance, the so-called First Triumvirate, with the consul Julius Caesar and the censor Marcus Licinius Crassus.</td>
<td></td>
</tr>
<tr>
<td>59 BC</td>
<td>Consulship of Julius Caesar.</td>
<td></td>
</tr>
<tr>
<td>58 BC</td>
<td><strong>Gallic Wars</strong>: Roman forces barred the westward migration of the Helvetii across the Rhône.</td>
<td></td>
</tr>
<tr>
<td>53 BC</td>
<td>6 May <strong>Battle of Carrhae</strong>: A Parthian army decisively defeated a numerically superior Roman invasion force near Harran. Crassus was killed.</td>
<td></td>
</tr>
<tr>
<td>50 BC</td>
<td><strong>Gallic Wars</strong>: The last Gaulish rebels were defeated.</td>
<td></td>
</tr>
<tr>
<td>49 BC</td>
<td>10 January <strong>Caesar's Civil War</strong>: Julius Caesar illegally crossed the Rubicon into Italy with his army.</td>
<td></td>
</tr>
<tr>
<td>48 BC</td>
<td>4 January <strong>Caesar's Civil War</strong>: Caesar landed at Durrës in pursuit of Pompey and his partisans the optimates.</td>
<td></td>
</tr>
<tr>
<td>46 BC</td>
<td>November Caesar left Africa for Iberia in pursuit of Pompey's sons Gnaeus Pompeius and Sextus Pompey.</td>
<td></td>
</tr>
<tr>
<td>44 BC</td>
<td>15 March <strong>Assassination of Julius Caesar</strong>: Caesar was assassinated in the Theatre of Pompey by a conspiracy of senators.</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Month</td>
<td>Event</td>
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</tr>
<tr>
<td>43 BC</td>
<td>November</td>
<td>The <em>Lex Titia</em> was passed, granting the Second Triumvirate of Octavius (later known as Augustus), Mark Antony and Marcus Aemilius Lepidus the power to make and annul laws and appoint magistrates.</td>
</tr>
<tr>
<td>42 BC</td>
<td></td>
<td><em>Liberators' civil war</em>: Augustus and Antony led some thirty legions to northern Greece in pursuit of Caesar's assassins Marcus Junius Brutus the Younger and Gaius Cassius Longinus.</td>
</tr>
<tr>
<td></td>
<td>23 October</td>
<td><em>Liberators' civil war</em>: Brutus committed suicide after being defeated in battle.</td>
</tr>
<tr>
<td>33 BC</td>
<td></td>
<td><em>Antony's Parthian War</em>: A campaign led by Antony against the Parthian Empire ended in failure. The Second Triumvirate expired.</td>
</tr>
<tr>
<td>31 BC</td>
<td>2 September</td>
<td><em>Battle of Actium</em>: Forces loyal to Augustus defeated Antony and his lover Cleopatra, queen of Egypt, in a naval battle near Actium.</td>
</tr>
<tr>
<td>30 BC</td>
<td>1 August</td>
<td><em>Final War of the Roman Republic</em>: Antony's forces defected to Augustus. He committed suicide.</td>
</tr>
<tr>
<td></td>
<td>30 August</td>
<td>Cleopatra committed suicide, probably in Roman custody and by snakebite.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The province of Egypt was organized. Augustus took the title pharaoh.</td>
</tr>
<tr>
<td>29 BC</td>
<td></td>
<td>Moesia was annexed to Rome.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Cantabrian Wars</em>: Rome deployed some eighty thousand soldiers against the Cantabri in Iberia.</td>
</tr>
<tr>
<td>27 BC</td>
<td>16 January</td>
<td>The Senate granted Augustus the titles <em>augustus</em>, majestic, and <em>princeps</em>, first.</td>
</tr>
<tr>
<td>25 BC</td>
<td></td>
<td>Augustus indicated his nephew Marcus Claudius Marcellus (Julio-Claudian dynasty) as his chosen successor by marrying him to his only daughter Julia the Elder.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Roman client Amyntas of Galatia died. Augustus organized his territory as the province of Galatia.</td>
</tr>
<tr>
<td>24 BC</td>
<td></td>
<td>Augustus' campaigns against the Cantabrians in Hispania Tarraconensis, the Cantabrian Wars, ended.</td>
</tr>
<tr>
<td>23 BC</td>
<td></td>
<td><em>Coinage reform of Augustus</em>: Augustus centralized the minting of and reformed the composition and value of the Roman currency.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Marcellus died.</td>
</tr>
</tbody>
</table>
21 BC
Augustus married Julia to his general Marcus Vipsanius Agrippa.

19 BC
*Cantabrian Wars:* The last major combat operations ended. The Cantabri and Astures were pacified.

17 BC
Augustus adopted the sons of Agrippa and Julia, his grandsons Gaius Caesar and Lucius Caesar, as his own sons.

16 BC
Raetia and Noricum were conquered and annexed to Rome.

12 BC
*Germanic Wars:* Roman forces crossed the Rhine into Germania.

Agrippa died of fever.

11 BC
Augustus married Julia to his general and stepson Tiberius.

9 BC
The Roman general Nero Claudius Drusus died from injuries sustained falling from a horse.

Pannonia was annexed and incorporated into Illyricum.

6 BC
Augustus offered Tiberius tribunician power and *imperium* over the eastern half of the Empire. Tiberius refused, announcing his retirement to Rhodes.

2 BC
Augustus was acclaimed *Pater Patriae*, father of the country, by the Senate.

Augustus convicted Julia of adultery and treason, annulled her marriage to Tiberius, and exiled her with her mother Scribonia to Ventotene.

1st century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
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<tbody>
<tr>
<td>AD 2</td>
<td>20 August</td>
<td>Lucius Caesar died of a sudden illness.</td>
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<tr>
<td></td>
<td></td>
<td>Augustus allowed Tiberius to return to Rome as a private citizen.</td>
</tr>
<tr>
<td>AD 4</td>
<td>21 February</td>
<td>Gaius Caesar died in Lycia from wounds suffered in battle.</td>
</tr>
</tbody>
</table>
Augustus adopted Tiberius as his son and granted him tribunician power.

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>AD 6</td>
<td>Augustus deposed Herod Archelaus, ethnarch in Samaria, Judea and Idumea, and organized the province of Judea on his territories.</td>
</tr>
<tr>
<td></td>
<td><em>Bellum Batonianum: The Daesititates, an Illyrian people, rose up against Roman authority in Illyricum.</em></td>
</tr>
<tr>
<td>AD 9</td>
<td><em>Bellum Batonianum: The Daesitiate chieftain Bato (Daesitiate chieftain) surrendered to Roman forces.</em></td>
</tr>
<tr>
<td></td>
<td>September <em>Battle of the Teutoburg Forest: A coalition of Germanic forces ambushed and destroyed three Roman legions in the Teutoburg Forest. Publius Quinctilius Varus, the commander of Roman forces in Germania, committed suicide.</em></td>
</tr>
<tr>
<td>AD 10</td>
<td>Tiberius assumed command of Roman forces in Germania.</td>
</tr>
<tr>
<td></td>
<td>Illyricum was divided into the provinces of Pannonia and Dalmatia.</td>
</tr>
<tr>
<td>AD 13</td>
<td>Tiberius was granted power equal to Augustus as <em>co-princeps.</em></td>
</tr>
<tr>
<td>AD 14</td>
<td>19 August Augustus died.</td>
</tr>
<tr>
<td></td>
<td>Germanicus, son of Nero Claudius Drusus and adoptive son of Tiberius, was appointed commander of Roman forces in Germania.</td>
</tr>
<tr>
<td></td>
<td>Germanicus and Tiberius's natural son Drusus Julius Caesar were sent to suppress mutinies in Germania and Pannonia, respectively.</td>
</tr>
<tr>
<td>AD 15</td>
<td>Lucius Seius Strabo was appointed governor of Egypt. His son Sejanus remained as the sole prefect of the Praetorian Guard.</td>
</tr>
<tr>
<td>AD 16</td>
<td><em>Battle of the Weser River: A Roman army led by Germanicus decisively defeated a Germanic force on the Weser.</em></td>
</tr>
<tr>
<td>AD 17</td>
<td>Archelaus of Cappadocia, king in Cappadocia and a Roman client, died. Tiberius annexed his territory, organizing it as the province of Cappadocia.</td>
</tr>
<tr>
<td></td>
<td>Antiochus III of Commagene, king of Commagene and a Roman client, died. Tiberius annexed his territory to the province of Syria.</td>
</tr>
<tr>
<td>Year</td>
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<tr>
<td>AD 18</td>
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<tr>
<td>AD 19</td>
<td>10 October</td>
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<td>AD 22</td>
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<tr>
<td>AD 23</td>
<td>14 September</td>
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<td>AD 26</td>
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<td>AD 28</td>
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<td>AD 29</td>
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<tr>
<td>AD 31</td>
<td>18 October</td>
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<tr>
<td>AD 37</td>
<td>16 March</td>
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<td>AD 38</td>
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<td>AD 40</td>
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<td>AD 41</td>
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<td>24 January</td>
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<td>AD 42</td>
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<td>AD 43</td>
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<tr>
<td>AD 46</td>
<td>Claudius annexed Lycia into the Empire as a province.</td>
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<tr>
<td>AD 48</td>
<td>The Odrysian king Rhoemetalces III, a Roman client, was killed by anti-Roman insurgents. Odrysia was incorporated into the Empire as the province of Thracia.</td>
</tr>
<tr>
<td>AD 49</td>
<td>Claudius's wife Messalina was executed for conspiracy. Claudius appointed Herod Agrippa's son Herod Agrippa II king of Judea.</td>
</tr>
<tr>
<td>AD 50</td>
<td>Claudius married his niece, Germanicus's daughter Agrippina the Younger.</td>
</tr>
<tr>
<td>AD 54</td>
<td>Claudius adopted Agrippina's son Nero as his own son.</td>
</tr>
<tr>
<td>AD 55</td>
<td>13 October Claudius died. Nero succeeded him as princeps.</td>
</tr>
<tr>
<td>AD 58</td>
<td>11 February Claudius's young natural son Britannicus died, probably by poison.</td>
</tr>
<tr>
<td>AD 60</td>
<td>Roman–Parthian War of 58–63: Roman forces attacked Armenia in support of their preferred king Tigranes VI of Armenia against the Parthian candidate Tiridates I of Armenia.</td>
</tr>
<tr>
<td>AD 61</td>
<td>23 March Agrippina died, probably murdered by her son Nero.</td>
</tr>
<tr>
<td>AD 65</td>
<td>Battle of Watling Street: Some eighty thousand soldiers and civilians among the Iceni and Trinovantes were killed, probably in the modern West Midlands, ending Boudica's revolt.</td>
</tr>
<tr>
<td>AD 63</td>
<td>Roman–Parthian War of 58–63: The Roman and Parthian Empires agreed that Tiridates and his descendants would remain kings of Armenia as Roman clients, ending the war.</td>
</tr>
<tr>
<td>AD 64</td>
<td>18 July Great Fire of Rome: A fire began which would cause massive property damage and loss of life over six days in Rome. Nero began construction of his large and extravagant villa the Domus Aurea.</td>
</tr>
<tr>
<td>AD 65</td>
<td>Pisonian conspiracy: Nero was informed of a broad conspiracy to assassinate him and appoint the senator Gaius Calpurnius Piso leader of Rome.</td>
</tr>
<tr>
<td>Year</td>
<td>Year-Date</td>
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<tr>
<td>AD 66</td>
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<td>AD 68</td>
<td>9 June</td>
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<tr>
<td>AD 69</td>
<td>15 January</td>
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<td>16 April</td>
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<td></td>
<td>December</td>
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<td></td>
<td>22 December</td>
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<td>AD 70</td>
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<td></td>
<td>September</td>
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<tr>
<td>AD 71</td>
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<tr>
<td>AD 73</td>
<td>16 April</td>
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<tr>
<td>AD 77</td>
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<tr>
<td>AD 79</td>
<td>23 June</td>
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<tr>
<td>Date</td>
<td>Event</td>
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<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>24 August</td>
<td><em>Eruption of Mount Vesuvius in 79</em>: Mount Vesuvius erupted, destroying the cities of Pompeii and Herculaneum.</td>
</tr>
<tr>
<td>AD 80</td>
<td>Rome was partially destroyed by fire.</td>
</tr>
<tr>
<td>March</td>
<td>The Colosseum was completed.</td>
</tr>
<tr>
<td>AD 81 13 September</td>
<td>Titus died of fever. He was succeeded by his younger brother Domitian.</td>
</tr>
<tr>
<td>AD 85</td>
<td>Agricola was recalled to Rome.</td>
</tr>
<tr>
<td>AD 86</td>
<td><em>Domitian's Dacian War</em>: The Dacian king Decebalus invaded Moesia.</td>
</tr>
<tr>
<td>AD 88</td>
<td><em>Domitian's Dacian War</em>: Decebalus agreed to return all Roman prisoners of war and accept his status as a Roman client in exchange for an annual subsidy of eight million sestertii, ending the war.</td>
</tr>
<tr>
<td>AD 89 1 January</td>
<td>Lucius Antonius Saturninus, governor of Germania Superior, revolted against Domitian's rule. Saturninus was executed.</td>
</tr>
<tr>
<td>AD 96 18 September</td>
<td>Domitian was assassinated by members of the royal household. Nerva was declared ruler of Rome by the Senate.</td>
</tr>
<tr>
<td>AD 97</td>
<td>Nerva adopted the general and former consul Trajan as his son.</td>
</tr>
<tr>
<td>AD 98 27 January</td>
<td>Nerva died. Trajan succeeded him.</td>
</tr>
</tbody>
</table>

2nd century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>101</td>
<td>September</td>
<td><em>First Dacian War</em>: Rome invaded Dacia.</td>
</tr>
<tr>
<td></td>
<td>September</td>
<td><em>Second Battle of Tapae</em>: Dacian forces retreated from contact with the Romans at Tapae.</td>
</tr>
<tr>
<td>102</td>
<td></td>
<td><em>First Dacian War</em>: The Dacian king Decebalus reaffirmed his loyalty to Rome, ending the war.</td>
</tr>
<tr>
<td>105</td>
<td><strong>Second Dacian War</strong>: Trajan responded to the resumption of raids on Roman settlements in Moesia by invading Dacia.</td>
<td></td>
</tr>
<tr>
<td>106</td>
<td><strong>Battle of Sarmisegetusa</strong>: Roman forces breached the Dacian capital Sarmizegetusa Regia. The Dacian king Decebalus escaped to the east.</td>
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<tr>
<td></td>
<td>The Nabatean king Rabbel II Soter died.</td>
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<tr>
<td>22 March</td>
<td>Nabatea was annexed to the Roman empire as the province of Arabia Petraea.</td>
<td></td>
</tr>
<tr>
<td>107</td>
<td><strong>Second Dacian War</strong>: The Dacian king Decebalus committed suicide in his fortification at Ranaissorum to avoid capture.</td>
<td></td>
</tr>
<tr>
<td>112</td>
<td>The province of Dacia was organized.</td>
<td></td>
</tr>
<tr>
<td>113</td>
<td><strong>Roman–Parthian Wars</strong>: Trajan launched an expedition against Parthia.</td>
<td></td>
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<tr>
<td></td>
<td>Trajan's Column was erected in Trajan's Forum to commemorate the victory over Dacia.</td>
<td></td>
</tr>
<tr>
<td>114</td>
<td>Trajan deposed the Armenian king Parthamasiris of Armenia, a Roman client, and organized the province of Armenia on his territory.</td>
<td></td>
</tr>
<tr>
<td>115</td>
<td><strong>Kitos War</strong>: The Jews in Cyrene rose up against Roman authority.</td>
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</tr>
<tr>
<td>116</td>
<td>The provinces of Mesopotamia and Assyria were organized on territory conquered from Parthia.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Trajan captured the Parthian capital Ctesiphon and deposed its shah Osroes I in favor of his son Parthamaspates of Parthia.</td>
<td></td>
</tr>
<tr>
<td>117</td>
<td><strong>Kitos War</strong>: Roman forces captured the rebel stronghold of Lod and executed many of its inhabitants.</td>
<td></td>
</tr>
<tr>
<td>8 August</td>
<td>Trajan died.</td>
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<tr>
<td>10 August</td>
<td>The Senate accepted the general Hadrian as ruler of Rome, following the appearance of documents indicating he had been adopted by Trajan.</td>
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<tr>
<td></td>
<td>Osroes I deposed his son Parthamaspates of Parthia and replaced him as shah of Parthia.</td>
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</tr>
<tr>
<td>118</td>
<td>Hadrian withdrew from the territories of Armenia, Assyria and Mesopotamia, allowing the return of</td>
<td></td>
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<tr>
<td>Year</td>
<td>Event</td>
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<tr>
<td>119</td>
<td>A rebellion took place in Britain.</td>
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<tr>
<td>122</td>
<td>The construction of Hadrian’s Wall at the northern border of Britain began.</td>
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<tr>
<td>123</td>
<td>Hadrian arrived in Mauretania to suppress a local revolt.</td>
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<tr>
<td>124</td>
<td>Hadrian travelled to Greece.</td>
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</tr>
<tr>
<td>126</td>
<td>Hadrian returned to Rome. The rebuilt Pantheon was dedicated to Agrippa, its original builder.</td>
<td></td>
</tr>
<tr>
<td>132</td>
<td><strong>Bar Kokhba revolt</strong>: Simon bar Kokhba, believed by his followers to be the Messiah, launched a revolt against Roman authority in Judea.</td>
<td></td>
</tr>
<tr>
<td>135</td>
<td><strong>Bar Kokhba revolt</strong>: The revolt ended at a cost of tens of thousands of Roman soldiers and some six hundred thousand Jewish rebels and civilians, including bar Kokhba, killed. Judea and Syria were combined into the single province of Syria Palaestina.</td>
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</tr>
<tr>
<td>136</td>
<td>Hadrian adopted Lucius Aelius as his son and successor.</td>
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</tr>
<tr>
<td>138</td>
<td>1 January Lucius Aelius died. 25 February Hadrian adopted Antoninus Pius as his son and successor and granted him tribunician power and <em>imperium</em>, on the condition that he in turn adopt Marcus Aurelius and Lucius Verus as his sons. 10 July Hadrian died, probably from failure. 11 July Antoninus succeeded Hadrian.</td>
<td></td>
</tr>
<tr>
<td>141</td>
<td><strong>Roman conquest of Britain</strong>: Roman forces invaded modern Scotland under the command of the British governor Quintus Lollius Urbicus.</td>
<td></td>
</tr>
<tr>
<td>142</td>
<td>The construction of the Antonine Wall at the northern border of Britain began.</td>
<td></td>
</tr>
<tr>
<td>161</td>
<td>7 March Antoninus died. He was succeeded by Marcus and Lucius Verus. <strong>Roman–Parthian War of 161–166</strong>: The Parthian Empire deposed the Armenian king Sohaemus of Armenia, a Roman client, and installed Bakur.</td>
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<tr>
<td>Year</td>
<td>Event</td>
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</tr>
<tr>
<td>165</td>
<td><em>Antonine Plague</em>: A pandemic, probably of smallpox or measles, began which would kill some five million people throughout the Roman Empire.</td>
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<tr>
<td>166</td>
<td><em>Roman–Parthian War of 161–166</em>: Roman forces sacked the Parthian capital Ctesiphon.</td>
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<tr>
<td>169</td>
<td>Lucius Verus died of disease, leaving Marcus the sole ruler of Rome.</td>
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</tr>
<tr>
<td>175</td>
<td><em>Marcomannic Wars</em>: A coalition of Germanic tribes led by the Marcomanni invaded the Roman Empire across the Danube.</td>
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<tr>
<td>177</td>
<td>Marcus named his natural son Commodus co-ruler with himself.</td>
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<tr>
<td>180</td>
<td>17 March Marcus died. August 29 Commodus was strangled to death.</td>
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<tr>
<td>184</td>
<td>The fate of the year ended. The Antonine Wall was abandoned by Roman forces.</td>
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</tr>
<tr>
<td>192</td>
<td>December Commodus was strangled to death.</td>
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</tr>
<tr>
<td>193</td>
<td>1 January The Praetorian Guard acclaimed the consul Pertinax ruler of Rome at the Castra Praetoria.</td>
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<tr>
<td></td>
<td>28 March Pertinax was assassinated by the Praetorian Guard. The Praetorian Guard acclaimed the former consul Didius Julianus, who had provided the highest bid, ruler of Rome.</td>
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</tr>
<tr>
<td></td>
<td>9 April Pescennius Niger, the <em>legatus Augusti pro praetore</em> of Syria Palaestina, was proclaimed ruler of Rome by his legions.</td>
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<tr>
<td></td>
<td>14 April The Legio XIV Gemina acclaimed its commander Septimius Severus ruler of Rome at Carnuntum.</td>
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<tr>
<td></td>
<td>May The Senate recognized Septimius Severus as ruler of Rome and sentenced Julianus to death.</td>
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</tr>
<tr>
<td>194</td>
<td><em>Battle of Issus (194)</em>: Niger's forces were decisively defeated by the armies of Septimius Severus at Issus.</td>
<td></td>
</tr>
</tbody>
</table>
Clodius Albinus, the commander of Roman troops in Britain and Iberia, took the title *Imperator Caesar Decimus Clodius Septimius Albinus Augustus*.

**Battle of Lugdunum:** Septimius Severus and Albinus met in battle at Lugdunum.

Albinus committed suicide or was killed.

*Roman–Parthian Wars:* Septimius Severus sacked the Parthian capital Ctesiphon.

Septimius Severus appointed his eldest natural son Caracalla co-ruler with himself.

### 3rd century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>208</td>
<td></td>
<td><em>Roman invasion of Caledonia 208–210:</em> Septimius Severus invaded modern Scotland.</td>
</tr>
<tr>
<td>209</td>
<td></td>
<td>Septimius Severus named his youngest natural son Publius Septimius Geta co-ruler with himself and Caracalla.</td>
</tr>
<tr>
<td>211</td>
<td>4 February</td>
<td>Septimius Severus died.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Roman invasion of Caledonia 208–210:</em> Caracalla ended the campaign.</td>
</tr>
<tr>
<td>217</td>
<td>8 April</td>
<td>Caracalla was assassinated by a member of his bodyguard.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Praetorian Guard acclaimed their prefect Macrinus ruler of Rome.</td>
</tr>
<tr>
<td>218</td>
<td>8 June</td>
<td>Macrinus was captured and executed by an army loyal to Elagabalus, supposedly the illegitimate son of Caracalla.</td>
</tr>
<tr>
<td>222</td>
<td>11 March</td>
<td>Elagabalus was assassinated by the Praetorian Guard, which installed his young cousin Severus Alexander as ruler of Rome.</td>
</tr>
<tr>
<td>230</td>
<td></td>
<td><em>Roman–Persian Wars:</em> The Sasanian shah Ardashir I invaded Mesopotamia and Syria.</td>
</tr>
<tr>
<td>232</td>
<td></td>
<td><em>Roman–Persian Wars:</em> Alexander repelled the Sasanian invasion.</td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>235</td>
<td>19 March</td>
<td>Alexander was killed in a mutiny of the Legio XXII Primigenia at Mainz.</td>
</tr>
<tr>
<td></td>
<td>20 March</td>
<td>The army elected Maximinus Thrax, commander of the Legio IV Italica, ruler of Rome.</td>
</tr>
<tr>
<td>238</td>
<td>22 March</td>
<td>Gordian I, governor of Africa, accepted the rule of Rome at the urging of rebels in his province. He appointed his son Gordian II to rule jointly with him.</td>
</tr>
<tr>
<td></td>
<td>2 April</td>
<td>The Senate accepted Gordian I and Gordian II as rulers of Rome.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Battle of Carthage (238)</em>: Forces loyal to Gordian I and Gordian II were defeated by the army of Capelianus, the governor of Numidia, who claimed fealty to Maximinus. Gordian II was killed. Gordian I committed suicide.</td>
</tr>
<tr>
<td></td>
<td>22 April</td>
<td>The Senate elected two senators, Pupienus and Balbinus, as joint rulers of the Empire. Facing popular opposition to Pupienus and Balbinus, the Senate gave Gordian I's young grandson Gordian III the title Caesar.</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td>Maximinus was murdered with his son during a mutiny of the Legio II Parthica at Aquileia.</td>
</tr>
<tr>
<td></td>
<td>29 July</td>
<td>Pupienus and Balbinus were tortured and murdered by the Praetorian Guard in their barracks.</td>
</tr>
<tr>
<td>243</td>
<td></td>
<td><em>Battle of Resaena</em>: Roman forces defeated the Sasanian Empire at Resaena.</td>
</tr>
<tr>
<td>244</td>
<td></td>
<td><em>Battle of Misiche</em>: The Sasanian Empire decisively defeated a Roman force at Misiche, near modern Fallujah. Gordian III was killed, probably by a fellow Roman. He was succeeded by Philip the Arab, the prefect of the Praetorian Guard, who was forced to cede Mesopotamia and Armenia to the Sasanian Empire.</td>
</tr>
<tr>
<td>249</td>
<td></td>
<td>Philip was killed at Verona in battle with Decius, commander of Roman forces in Pannonia and Moesia.</td>
</tr>
<tr>
<td>251</td>
<td></td>
<td>Decius appointed his natural son Herennius Etruscus co-ruler of Rome jointly with himself.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Battle of Abritus</em>: Roman forces were dealt a bloody defeat by the Goths near modern Razgrad. Decius and Herennius were killed.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The armies of the Danube region acclaimed their commander Trebonianus Gallus ruler of Rome.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Senate recognized Decius's son Hostilian as ruler of Rome. Gallus adopted Hostilian as his son.</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
<td></td>
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</tr>
<tr>
<td>253</td>
<td><strong>Plague of Cyprian</strong>: Hostilian died, probably of plague.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Gallus appointed his natural son Volusianus co-ruler jointly with himself.</td>
<td></td>
</tr>
<tr>
<td>253</td>
<td><strong>Battle of Barbalissos</strong>: A Sasanian force destroyed a Roman army at Barbalissos.</td>
<td></td>
</tr>
<tr>
<td>August</td>
<td>Gallus and Volusianus were killed in a mutiny at Terni. The army acclaimed Aemilianus, governor of Pannonia and Moesia, ruler of Rome.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Aemilianus was killed by his own soldiers in the face of the army of the general Valerian (emperor).</td>
<td></td>
</tr>
<tr>
<td>22 October</td>
<td>Valerian gave his son Gallienus the title Caesar.</td>
<td></td>
</tr>
<tr>
<td>256</td>
<td>The Sasanian Empire conquered and sacked Antioch.</td>
<td></td>
</tr>
<tr>
<td>257</td>
<td>Valerian reconquered Antioch.</td>
<td></td>
</tr>
<tr>
<td>258</td>
<td>The Goths invaded Asia Minor.</td>
<td></td>
</tr>
<tr>
<td>260</td>
<td>Death of Dacian king Regalianus that became Roman emperor for a brief period.</td>
<td></td>
</tr>
<tr>
<td>260</td>
<td>Valerian was taken prisoner by the Sasanian Empire during truce negotiations.</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>The general Postumus was declared ruler of Rome in the Gallic Empire.</td>
<td></td>
</tr>
<tr>
<td>264</td>
<td>Valerian died in captivity.</td>
<td></td>
</tr>
<tr>
<td>267</td>
<td>Odaenathus, the king of Palmyra and a Roman client, was assassinated. His widow Zenobia took power as regent for their son Vaballathus.</td>
<td></td>
</tr>
<tr>
<td>268</td>
<td>Gallienus was murdered by his soldiers during a siege of Pontirolo Nuovo.</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>The general Claudius Gothicus was declared ruler of Rome by his soldiers.</td>
<td></td>
</tr>
<tr>
<td>269</td>
<td>Postumus was killed by his soldiers, who in turn acclaimed one of their own, Marcus Aurelius Marius, emperor of the Gallic Empire.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marius was murdered by Victorinus, formerly prefect of Postumus's Praetorian Guard, who replaced him as emperor of the Gallic Empire.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Zenobia conquered Egypt.</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
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<tr>
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</tr>
<tr>
<td>270</td>
<td><strong>Battle of Naissus</strong>: Roman forces decisively defeated the Goths at modern Niš, stalling an invasion of the Balkans.</td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>Claudius Gothicus died. He was succeeded by his brother Quintillus.</td>
<td></td>
</tr>
<tr>
<td>April</td>
<td>Quintillus died at Aquileia.</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>Aurelian became ruler of Rome.</td>
<td></td>
</tr>
<tr>
<td>271</td>
<td><strong>Battle of Fano</strong>: A Roman force defeated the Juthungi on the Metauro.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Victorinus was murdered by an officer he had cuckolded.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Tetricus I, <em>praeses</em> of Gallia Aquitania was acclaimed emperor of the Gallic Empire. He appointed his natural son Tetricus II to rule jointly with him.</td>
<td></td>
</tr>
<tr>
<td>272</td>
<td>Zenobia was arrested <em>en route</em> to refuge in the Sasanian Empire.</td>
<td></td>
</tr>
<tr>
<td>273</td>
<td>Palmyra rebelled against Roman authority and was destroyed.</td>
<td></td>
</tr>
<tr>
<td>274</td>
<td><strong>Battle of Châlons (274)</strong>: Aurelian defeated the forces of Tetricus I and Tetricus II at modern Châlons-en-Champagne.</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>Aurelian was murdered by the Praetorian Guard.</td>
<td></td>
</tr>
<tr>
<td>25 September</td>
<td>The Senate elected Tacitus (emperor) ruler of Rome.</td>
<td></td>
</tr>
<tr>
<td>276</td>
<td>June  Tacitus died.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Marcus Aurelius Probus, commander of Roman forces in the east and Tacitus's half-brother, was acclaimed ruler of Rome by his troops.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Florianus, prefect of the Praetorian Guard and commander of Roman forces in the west, was acclaimed ruler of Rome by his troops.</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>Florianus was assassinated near Tarsus by his troops following a defeat at the hands of Probus.</td>
<td></td>
</tr>
<tr>
<td>279</td>
<td>Probus launched a campaign against the Vandals in Illyricum.</td>
<td></td>
</tr>
<tr>
<td>282</td>
<td>The Praetorian Guard elected their prefect Carus ruler of Rome.</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
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<td>------</td>
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<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>283</td>
<td></td>
<td>Probus was assassinated.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Carus gave his sons Carinus and Numerian the title Caesar.</td>
</tr>
<tr>
<td>283</td>
<td></td>
<td>Carus died.</td>
</tr>
<tr>
<td>284</td>
<td></td>
<td>Numerian died.</td>
</tr>
<tr>
<td>285</td>
<td>20 November</td>
<td>Roman forces in the east elected the consul Diocletian their ruler and proclaimed him <em>augustus</em>.</td>
</tr>
<tr>
<td>285</td>
<td>July</td>
<td><em>Battle of the Margus</em>: Forces loyal to Diocletian defeated Carinus in battle on the Morava. Carinus was killed.</td>
</tr>
<tr>
<td>285</td>
<td>July</td>
<td>Diocletian gave Maximian the title Caesar.</td>
</tr>
<tr>
<td>286</td>
<td></td>
<td><em>Carausian Revolt</em>: The naval commander Carausius declared himself emperor in Britain and northern Gaul.</td>
</tr>
<tr>
<td>286</td>
<td>2 April</td>
<td>Diocletian proclaimed Maximian <em>augustus</em> of the west, ruling himself as <em>augustus</em> of the east.</td>
</tr>
<tr>
<td>293</td>
<td></td>
<td>Diocletian established the Tetrarchy, appointing Constantius Chlorus to hold the office of Caesar under Maximian in the west and Galerius to hold the title under himself in the east.</td>
</tr>
<tr>
<td>293</td>
<td></td>
<td><em>Carausian Revolt</em>: Constantius Chlorus conquered Carausius's Gallic territories.</td>
</tr>
<tr>
<td>293</td>
<td></td>
<td>Carausius was murdered by his finance minister Allectus, who replaced him as emperor in Britain.</td>
</tr>
<tr>
<td>296</td>
<td></td>
<td><em>Carausian Revolt</em>: Allectus was defeated in battle and killed at Calleva Atrebatum.</td>
</tr>
</tbody>
</table>

**4th century**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>301</td>
<td></td>
<td>Diocletian issued the Edict on Maximum Prices, reforming the currency and setting price ceilings on a number of goods.</td>
</tr>
<tr>
<td>303</td>
<td>24 February</td>
<td><em>Diocletianic Persecution</em>: Diocletian issued his first edict against Christians, calling for the destruction of Christian holy books and places of worship and stripping Christians of their government positions and political rights.</td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
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<td>------</td>
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</tr>
<tr>
<td>305</td>
<td>1 May</td>
<td>Diocletian and Maximian abdicated. Constantius and Galerius were elevated to <em>augusti</em> in the west and east. Galerius appointed Flavius Valerius Severus Caesar in the west and Maximinus II Caesar in the east.</td>
</tr>
<tr>
<td>306</td>
<td>25 July</td>
<td>Constantius died at Eboracum. By his dying wish, his troops acclaimed his son Constantine the Great <em>augustus</em>. Galerius recognized Flavius Valerius Severus as <em>augustus</em> in the west and granted Constantine the Great the lesser title of Caesar, which he accepted.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Civil wars of the Tetrarchy</em>: Rioters in Rome acclaimed Maximian's son Maxentius ruler of Rome. He took the title <em>princeps invictus</em>, undefeated prince.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maxentius invited Maximian to reclaim the title <em>augustus</em>.</td>
</tr>
<tr>
<td>307</td>
<td></td>
<td><em>Civil wars of the Tetrarchy</em>: Flavius Valerius Severus surrendered to Maximian at Ravenna.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Civil wars of the Tetrarchy</em>: Galerius laid siege to Rome. Many of his soldiers defected to Maxentius and he was forced to flee.</td>
</tr>
<tr>
<td>308</td>
<td></td>
<td><em>Civil wars of the Tetrarchy</em>: After a failed <em>coup</em> against his son Maxentius, Maximian was forced to flee to Constantine's court.</td>
</tr>
<tr>
<td></td>
<td>11 November</td>
<td>Maximian resigned as <em>augustus</em>. Galerius appointed Licinius <em>augustus</em> of the west and confirmed his recognition of Constantine the Great as Caesar of the west.</td>
</tr>
<tr>
<td>310</td>
<td>July</td>
<td><em>Civil wars of the Tetrarchy</em>: Maximian was forced to commit suicide following a failed <em>coup</em> against Constantine the Great.</td>
</tr>
<tr>
<td>311</td>
<td>May</td>
<td>Galerius died. Licinius and Maximinus agreed to divide the eastern Empire between themselves.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Civil wars of the Tetrarchy</em>: Constantine the Great concluded an alliance with Licinius, offering his half-sister Flavia Julia Constantia to him in marriage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Civil wars of the Tetrarchy</em>: Maximinus entered a secret alliance with Maxentius.</td>
</tr>
<tr>
<td></td>
<td>3 December</td>
<td>Diocletian died, possibly from suicide.</td>
</tr>
</tbody>
</table>
| 312  | 28     | *Battle of the Milvian Bridge*: Constantine the Great had a vision of the cross appearing over the sun at
<table>
<thead>
<tr>
<th>Month</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>October</td>
<td></td>
<td>the Ponte Milvio with the words &quot;in this sign, conquer.&quot; His forces defeated and killed Maxentius.</td>
</tr>
<tr>
<td>313</td>
<td>February</td>
<td>Constantine the Great and Licinius issued the Edict of Milan, providing for restitution to Christians injured during the persecutions.</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>Licinius married Constantia.</td>
</tr>
<tr>
<td>30 April</td>
<td></td>
<td><em>Battle of Tzirallum</em>: Licinius defeated a vastly numerically superior force loyal to Maximinus at modern Çorlu. Maximinus fled to Nicomedia.</td>
</tr>
<tr>
<td>August</td>
<td></td>
<td>Maximinus died at Tarsus.</td>
</tr>
<tr>
<td>314</td>
<td>8 October</td>
<td><em>Battle of Cibalae</em>: Constantine the Great dealt a bloody defeat to Licinius's forces at modern Vinkovci.</td>
</tr>
<tr>
<td>317</td>
<td></td>
<td><em>Battle of Mardia</em>: After a bloody battle, probably at modern Harmanli, Licinius retreated from contact with Constantine the Great.</td>
</tr>
<tr>
<td></td>
<td>1 March</td>
<td>Licinius recognized Constantine the Great as his superior, ceded all his territories outside of Thrace, and agreed to depose and execute Valerius Valens, whom he had raised to <em>augustus</em>.</td>
</tr>
<tr>
<td>324</td>
<td>3 July</td>
<td><em>Battle of Adrianople (324)</em>: Licinius suffered a bloody defeat at the hands of Constantine the Great on the Maritsa.</td>
</tr>
<tr>
<td></td>
<td>18 September</td>
<td><em>Battle of Chrysopolis</em>: Constantine the Great dealt a decisive defeat to the remnants of Licinius's army. Licinius surrendered.</td>
</tr>
<tr>
<td>325</td>
<td>20 May</td>
<td><em>First Council of Nicaea</em>: An ecumenical council called by Constantine the Great at Nicaea opened which would establish the Nicene Creed, asserting Jesus to be equal to and of the same substance as God the Father.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Licinius was executed.</td>
</tr>
<tr>
<td>326</td>
<td></td>
<td>Constantine the Great ordered the death of his oldest son Crispus.</td>
</tr>
<tr>
<td>330</td>
<td>11 May</td>
<td>Constantine the Great moved his capital to Byzantium and renamed the city Constantinople, city of Constantine.</td>
</tr>
<tr>
<td>332</td>
<td></td>
<td>Constantine the Great campaigned against the Goths.</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
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</tr>
<tr>
<td>334</td>
<td>Constantine the Great campaigned against the Sarmatians.</td>
<td></td>
</tr>
<tr>
<td>337</td>
<td>Roman–Persian Wars: The Sasanian shah Shapur II invaded Armenia and Mesopotamia.</td>
<td></td>
</tr>
<tr>
<td>22 May</td>
<td>Constantine the Great died.</td>
<td></td>
</tr>
<tr>
<td>9 September</td>
<td>Constantine the Great's three sons declared themselves <em>augusti</em> and divided their father's empire into three parts, with Constantine II (emperor) receiving Britain, Iberia, Gaul and Illyria, Constantius II Asia, Syria Palaestina and Egypt, and Constans Italy and Africa. The young Constans was placed under Constantine II's guardianship.</td>
<td></td>
</tr>
<tr>
<td>338</td>
<td>Constantine II campaigned against the Alemanni.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constantine II granted Illyria to his brother Constans.</td>
<td></td>
</tr>
<tr>
<td>340</td>
<td>Constantine II invaded Italy. He was ambushed and slain at Aquileia by Constans, who inherited his territory.</td>
<td></td>
</tr>
<tr>
<td>341</td>
<td>Constans and Constantius II issued a ban against pagan sacrifice.</td>
<td></td>
</tr>
<tr>
<td>344</td>
<td>Siege of Singara: Sasanian forces failed to capture the Roman fortress of Singara.</td>
<td></td>
</tr>
<tr>
<td>350 18 January</td>
<td>Magnentius, commander of the Jovians and Herculians, was acclaimed ruler of Rome by his legions.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Constans was killed in Elne by followers of Magnentius.</td>
<td></td>
</tr>
<tr>
<td>3 June</td>
<td>Constantius Chlorus's grandson Nepotianus entered Rome with a band of gladiators and there declared himself imperator.</td>
<td></td>
</tr>
<tr>
<td>30 June</td>
<td>Marcellinus (magister officiorum), one of Magnentius's generals, entered Rome and executed Nepotianus.</td>
<td></td>
</tr>
<tr>
<td>351 15 March</td>
<td>Constantius II granted his cousin Constantius Gallus the title Caesar.</td>
<td></td>
</tr>
<tr>
<td>28 September</td>
<td>Battle of Mursa Major: Constantius II defeated Magnentius in a bloody battle in the valley of the Drava.</td>
<td></td>
</tr>
<tr>
<td>353</td>
<td>Battle of Mons Seleucus: Constantius II dealt Magnentius a decisive defeat at modern La Bâtie-Montsaléon. Magnentius committed suicide.</td>
<td></td>
</tr>
<tr>
<td>354</td>
<td>Gallus was put to death.</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Month</td>
<td>Event</td>
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<tr>
<td>355</td>
<td>6 November</td>
<td>Constantius II declared Julian (emperor) Caesar and granted him command in Gaul.</td>
</tr>
<tr>
<td>357</td>
<td></td>
<td>Battle of Strasbourg: Julian defeated a vastly superior Alemanni force near Argentoratum, solidifying Roman control west of the Rhine.</td>
</tr>
<tr>
<td>360</td>
<td>February</td>
<td>The Petulantes, ordered east from Paris in preparation for a war with the Sasanian Empire, instead mutinied and proclaimed Julian <em>augustus</em>.</td>
</tr>
<tr>
<td>361</td>
<td>3 November</td>
<td>Constantius II named Julian as his successor before dying of fever.</td>
</tr>
<tr>
<td>363</td>
<td>5 March</td>
<td>Julian's Persian War: Roman forces embarked from Antioch on a punitive expedition against the Sasanian Empire.</td>
</tr>
<tr>
<td>363</td>
<td>26 June</td>
<td>Battle of Samarra: Sasanian forces harassed a Roman army in retreat at Samarra from a failed siege of their capital Ctesiphon. Julian was killed.</td>
</tr>
<tr>
<td>363</td>
<td>27 June</td>
<td>Julian's army declared one of their generals, Jovian (emperor), <em>augustus</em>.</td>
</tr>
<tr>
<td>363</td>
<td>July</td>
<td>Julian's Persian War: Jovian agreed to cede the five provinces east of the Tigris to the Sasanian Empire, ending the war.</td>
</tr>
<tr>
<td>364</td>
<td>17 February</td>
<td>Jovian died.</td>
</tr>
<tr>
<td>364</td>
<td>26 February</td>
<td>The army acclaimed the general Valentinian I the Great <em>augustus</em>.</td>
</tr>
<tr>
<td>364</td>
<td>28 March</td>
<td>Valentinian the Great appointed his younger brother Valens <em>augustus</em> with rule over the eastern Empire, and continued as <em>augustus</em> in the west.</td>
</tr>
<tr>
<td>375</td>
<td>17 November</td>
<td>Valentinian the Great died of a stroke. His son Gratian, then junior <em>augustus</em> in the west, succeeded him as senior <em>augustus</em>.</td>
</tr>
<tr>
<td>375</td>
<td>22 November</td>
<td>The army acclaimed Valentinian the Great's young son Valentinian II <em>augustus</em> of the west.</td>
</tr>
<tr>
<td>376</td>
<td></td>
<td>Fleeing Hunnic aggression, the Goths, under the leadership of the Thervingi chieftain Fritigern, crossed the Danube and entered the eastern Empire as political refugees.</td>
</tr>
</tbody>
</table>
Gothic War (376–382): Following the deaths of several Roman soldiers during civil unrest in Thrace, the officer Lupicinus (Roman) arrested Fritigern and the Greuthungi chieftain Alatheus.

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>378</td>
<td>9 August</td>
<td><em>Battle of Adrianople:</em> A combined Gothic-Alanic force decisively defeated the Roman army near Edirne. Valens was killed.</td>
</tr>
<tr>
<td>379</td>
<td>19 January</td>
<td>Gratian named the general Theodosius I the Great <em>augustus</em> in the east.</td>
</tr>
<tr>
<td>380</td>
<td>27 February</td>
<td>Theodosius the Great issued the Edict of Thessalonica, making Christianity the state church of the Roman Empire.</td>
</tr>
<tr>
<td>382</td>
<td>3 October</td>
<td><em>Gothic War (376–382)</em>: The Goths were made <em>foederati</em> of Rome and granted land and autonomy in Thrace, ending the war.</td>
</tr>
<tr>
<td>383</td>
<td>25 August</td>
<td>Gratian was delivered by mutineers to the <em>Magister equitum</em> Andragathius and executed.</td>
</tr>
<tr>
<td>392</td>
<td>15 May</td>
<td>Valentinian II was found hanged in his residence. He may have been murdered by his guardian, the Frankish general Arbogast (general).</td>
</tr>
<tr>
<td></td>
<td>22 August</td>
<td>Arbogast declared Eugenius <em>augustus</em> and ruler in the west.</td>
</tr>
<tr>
<td>393</td>
<td>23 January</td>
<td>Theodosius the Great appointed his younger son Honorius (emperor) <em>augustus</em> in the west.</td>
</tr>
<tr>
<td>394</td>
<td>6 September</td>
<td><em>Battle of the Frigidus:</em> Forces loyal to Theodosius the Great defeated and killed Arbogast and Eugenius, probably near the Vipava.</td>
</tr>
<tr>
<td>395</td>
<td>17 January</td>
<td>Theodosius the Great died. His elder son Arcadius succeeded him as <em>augustus</em> in the eastern Byzantine Empire. The young Honorius became sole <em>augustus</em> in the Western Roman Empire under the regency of <em>Magister militum</em> Stilicho.</td>
</tr>
<tr>
<td>398</td>
<td></td>
<td><em>Gildonic War:</em> Gildo, <em>comes</em> of Africa, was killed following a failed rebellion against the Western Roman Empire.</td>
</tr>
</tbody>
</table>

5th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>402</td>
<td></td>
<td>The capital of the Western Roman Empire was moved to Ravenna.</td>
</tr>
<tr>
<td>Year</td>
<td>Month</td>
<td>Event</td>
</tr>
<tr>
<td>------</td>
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<td>-------</td>
</tr>
<tr>
<td>406</td>
<td>December</td>
<td>Crossing of the Rhine: A coalition of foreign tribes including the Vandals, Alans and Suebi invaded the Western Roman Empire across the Rhine.</td>
</tr>
<tr>
<td>408</td>
<td>1 May</td>
<td>Arcadius died.</td>
</tr>
<tr>
<td>410</td>
<td>24 August</td>
<td>Sack of Rome (410): Rome was sacked by the Visigoths under their king Alaric I.</td>
</tr>
<tr>
<td>410</td>
<td></td>
<td>End of Roman rule in Britain: The last Roman forces left Britain.</td>
</tr>
<tr>
<td>421</td>
<td>8 February</td>
<td>Honorius appointed his brother-in-law and Magister militum Constantius III co-ruler of the Western Roman Empire with himself.</td>
</tr>
<tr>
<td>421</td>
<td>2 September</td>
<td>Constantius III died.</td>
</tr>
<tr>
<td>423</td>
<td>15 August</td>
<td>Honorius died.</td>
</tr>
<tr>
<td>423</td>
<td></td>
<td>The Western Roman patrician Castinus declared the primicerius Joannes augustus.</td>
</tr>
<tr>
<td>424</td>
<td>23 October</td>
<td>The Byzantine augustus Theodosius II the Younger, the Calligrapher named the young Valentinian III, his cousin and Constantius III's son, Caesar with rule over the west. His mother Galla Placidia was appointed regent.</td>
</tr>
<tr>
<td>425</td>
<td></td>
<td>Joannes was executed in Aquileia.</td>
</tr>
<tr>
<td>447</td>
<td></td>
<td>Battle of the Utus: The Huns under Attila defeated a Byzantine army in a bloody battle near the Vit.</td>
</tr>
<tr>
<td>450</td>
<td>28 July</td>
<td>Theodosius the Younger died in a riding accident.</td>
</tr>
<tr>
<td>452</td>
<td></td>
<td>Attila abandoned his invasion of Italy following a meeting at the Mincio with the pope Pope Leo I.</td>
</tr>
<tr>
<td>455</td>
<td>16 March</td>
<td>Valentinian III was assassinated on orders of the senator Petronius Maximus.</td>
</tr>
<tr>
<td>455</td>
<td>17 March</td>
<td>The Senate acclaimed Maximus augustus of the Western Roman Empire.</td>
</tr>
<tr>
<td>455</td>
<td>31 May</td>
<td>Maximus was killed by a mob as he attempted to flee Rome in the face of a Vandal advance.</td>
</tr>
<tr>
<td>456</td>
<td>2 June</td>
<td>Sack of Rome (455): The Vandals entered and began to sack Rome.</td>
</tr>
<tr>
<td>455</td>
<td>9 July</td>
<td>The Magister militum Avitus was pronounced augustus of the Western Roman Empire at Toulouse by the Visigothic king Theodoric II.</td>
</tr>
<tr>
<td>Year</td>
<td>Month</td>
<td>Event</td>
</tr>
<tr>
<td>------</td>
<td>-------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>456</td>
<td>17 October</td>
<td>Avitus was forced to flee Rome following a military <em>coup</em> by the general Ricimer and the <em>domesticus</em> Majorian.</td>
</tr>
<tr>
<td>457</td>
<td></td>
<td>Avitus died.</td>
</tr>
<tr>
<td>457</td>
<td>27 January</td>
<td>The Byzantine <em>augustus</em> Marcian died.</td>
</tr>
<tr>
<td>457</td>
<td>28 February</td>
<td>The Byzantine <em>augustus</em> Leo I the Thracian appointed Majorian <em>Magister militum</em> in the west.</td>
</tr>
<tr>
<td></td>
<td>1 April</td>
<td>The army acclaimed Majorian <em>augustus</em> of the Western Roman Empire.</td>
</tr>
<tr>
<td>461</td>
<td>7 August</td>
<td>Majorian was killed after torture near the Staffora on Ricimer's orders.</td>
</tr>
<tr>
<td></td>
<td>19 November</td>
<td>The Senate elected Libius Severus from among their number as <em>augustus</em> of the Western Roman Empire.</td>
</tr>
<tr>
<td>465</td>
<td>15 August</td>
<td>Severus died.</td>
</tr>
<tr>
<td>467</td>
<td>12 April</td>
<td>Leo the Thracian elevated the <em>comes</em> Anthemius to Caesar with rule over the Western Roman Empire.</td>
</tr>
<tr>
<td>468</td>
<td></td>
<td><em>Battle of Cap Bon (468)</em>: The Vandal Kingdom destroyed a combined Western Roman and Byzantine invasion fleet at Cap Bon.</td>
</tr>
<tr>
<td>472</td>
<td>11 July</td>
<td>Anthemius was killed in flight following Ricimer's conquest of Rome. Maximus's son Olybrius was acclaimed <em>augustus</em> of the Western Roman Empire.</td>
</tr>
<tr>
<td></td>
<td>18 August</td>
<td>Ricimer died.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ricimer's nephew Gundobad succeeded him as <em>Magister militum</em> and took the title Patrician.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Olybrius died.</td>
</tr>
<tr>
<td>473</td>
<td>3 March</td>
<td>The Germanic elements of the army elected the <em>domesticus</em> Glycerius <em>augustus</em> of the Western Roman Empire.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Gundobad relinquished his Western Roman titles to succeed his father as king of Burgundy.</td>
</tr>
<tr>
<td>474</td>
<td></td>
<td>Leo the Thracian appointed Julius Nepos, his nephew and governor of Dalmatia, ruler of the Western Roman Empire in opposition to Glycerius.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>18 January</td>
<td>Leo the Thracian died. He was succeeded by his grandson Leo II (emperor).</td>
<td></td>
</tr>
<tr>
<td>9 February</td>
<td>Zeno (emperor) became co-augustus of the Byzantine Empire with his young son Leo II.</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>Nepos deposed Glycerius.</td>
<td></td>
</tr>
<tr>
<td>17 November</td>
<td>Leo II died, possibly after being poisoned by his mother Ariadne (empress).</td>
<td></td>
</tr>
<tr>
<td>475 January</td>
<td>Zeno was forced to flee Constantinople for his homeland Isauria in the face of a popular revolt.</td>
<td></td>
</tr>
<tr>
<td>9 January</td>
<td>Basiliscus, brother of Leo the Thracian's widow Verina, was acclaimed augustus of the Byzantine Empire by the Byzantine Senate.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Nepos appointed Orestes (father of Romulus Augustulus) Magister militum and commander-in-chief of the Western Roman military.</td>
<td></td>
</tr>
<tr>
<td>28 August</td>
<td>Orestes took control of the Western Roman capital Ravenna, forcing Nepos to flee to Dalmatia.</td>
<td></td>
</tr>
<tr>
<td>31 October</td>
<td>Orestes declared his young son Romulus Augustulus augustus of the Western Roman Empire.</td>
<td></td>
</tr>
<tr>
<td>476 August</td>
<td>Zeno recaptured Constantinople and accepted Basiliscus's surrender.</td>
<td></td>
</tr>
<tr>
<td>23 August</td>
<td>Germanic foederati under the command of the general Odoacer renounced Western Roman authority and declared Odoacer their king.</td>
<td></td>
</tr>
<tr>
<td>28 August</td>
<td>Odoacer captured and executed Orestes at Piacenza.</td>
<td></td>
</tr>
<tr>
<td>4 September</td>
<td>Odoacer conquered the Western Roman capital Ravenna, forced Romulus to abdicate and declared himself king of Italy.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>The Senate sent Zeno the imperial regalia of the Western Roman Empire.</td>
<td></td>
</tr>
<tr>
<td>480 25 April</td>
<td>Nepos was murdered in his residence in Split.</td>
<td></td>
</tr>
<tr>
<td>491 9 April</td>
<td>Zeno died.</td>
<td></td>
</tr>
</tbody>
</table>

**6th century**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>6th</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Month</td>
<td>Event</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>518</td>
<td>July</td>
<td>Augustus Anastasius I Dicorus died.</td>
</tr>
</tbody>
</table>
| 527  | April | Augustus Justin I appointed his older son Justinian I the Great co-augustus with himself.  
1 August | Justin I died. |
| 529  | April | The *Codex Justinianus*, which attempted to consolidate and reconcile contradictions in Roman law, was promulgated. |
| 532  |       | Justinian the Great ordered the construction of the Hagia Sophia in Constantinople. |
| 533  | June  | *Vandalic War*: A Byzantine force under the general Belisarius departed for the Vandal Kingdom.  
13 September | *Battle of Ad Decimum*: A Byzantine army defeated a Vandal force near Carthage.  
15 December | *Battle of Tricamarum*: The Byzantines defeated a Vandal army and forced their king Gelimer into flight. |
| 534  | March | *Vandalic War*: Gelimer surrendered to Belisarius and accepted his offer of a peaceful retirement in Galatia, ending the war. The territory of the Vandal Kingdom was reorganized as the praetorian prefecture of Africa. |
| 535  |       | *Gothic War* (535–554): Byzantine forces crossing from Africa invaded Sicily, then an Ostrogothic possession. |
| 537  | December | The Hagia Sophia was completed. |
| 552  | July  | *Battle of Taginae*: A Byzantine army dealt a decisive defeat to the Ostrogoths at Gualdo Tadino. The Ostrogoth king Totila was killed. |
| 553  |       | *Battle of Mons Lactarius*: An Ostrogothic force was ambushed and destroyed at Monti Lattari on its way to relieve a Byzantine siege of Cumae. The Ostrogoth king Teia was killed. |
| 565  | March | Belisarius died. |
|      | 14    | Justinian the Great died. |
November

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>568</td>
<td></td>
<td>The Lombards invaded Italy.</td>
</tr>
<tr>
<td>573</td>
<td></td>
<td>The general Narses died.</td>
</tr>
<tr>
<td>574</td>
<td></td>
<td><em>Augustus</em> Justin II began to suffer from fits of insanity.</td>
</tr>
<tr>
<td>578</td>
<td>5 October</td>
<td>Justin II died.</td>
</tr>
<tr>
<td>582</td>
<td>14 August</td>
<td><em>Augustus</em> Tiberius II Constantine died.</td>
</tr>
</tbody>
</table>

7th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>602</td>
<td></td>
<td>Byzantine–Sasanian War of 602–628: The Sasanian Empire declared war on Byzantium.</td>
</tr>
<tr>
<td>607</td>
<td>1 August</td>
<td><em>Augustus</em> Phocas dedicated the Column of Phocas in the Roman Forum.</td>
</tr>
<tr>
<td>626</td>
<td>June</td>
<td>Siege of Constantinople (626): Sasanian and Avar forces laid siege to Constantinople.</td>
</tr>
<tr>
<td>634</td>
<td>April</td>
<td><em>Muslim conquest of the Levant</em>: A Rashidun army departed Medina for the Levant.</td>
</tr>
<tr>
<td>640</td>
<td>January</td>
<td><em>Muslim conquest of Egypt</em>: A Rashidun force laid siege to Pelusium.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The legions of the East Roman army were reorganized into themes.</td>
</tr>
<tr>
<td>641</td>
<td>8 November</td>
<td>Siege of Alexandria (641): Byzantine authorities in the Egyptian capital Alexandria surrendered to the besieging Rashidun army.</td>
</tr>
<tr>
<td>663</td>
<td></td>
<td>Basileus Constans II visited Rome.</td>
</tr>
<tr>
<td>698</td>
<td></td>
<td>Battle of Carthage (698): An Umayyad siege and blockade of Carthage forced the retreat of Byzantine forces. The city was conquered and destroyed.</td>
</tr>
</tbody>
</table>

8th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Siege of Constantinople (717–718)

- **717**: The Umayyad Caliphate besieges the city of Constantinople.
- **718**: The Umayyad Caliphate lifts the siege of Constantinople due to Famine, Disease and an unusually hard winter.

### Basileus Leo III

- **730**: Basileus Leo III the Isaurian promulgated an edict forbidding the veneration of religious images, beginning the first Byzantine Iconoclasm.

### Second Council of Nicaea

- **787**: An ecumenical council in Nicaea ended which endorsed the veneration of images, ending the first Byzantine Iconoclasm.

## 9th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>813</td>
<td>June</td>
<td>A group of soldiers broke into the Church of the Holy Apostles and pleaded with the body of the iconoclast basileus Constantine V to restore the Empire, marking the beginning of the second Byzantine Iconoclasm.</td>
</tr>
<tr>
<td>843</td>
<td></td>
<td>The Byzantine regent Theodora (wife of Theophilus) restored the veneration of religious images, ending the second Byzantine Iconoclasm.</td>
</tr>
<tr>
<td>867</td>
<td>24 September</td>
<td>Basileus Michael III was assassinated by his co-basileus Basil I, who became sole ruler of the Empire.</td>
</tr>
</tbody>
</table>

## 10th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>976</td>
<td>10 January</td>
<td>Basileus John I Tzimiskes died. His co-basileus and nephew Basil II became sole ruler of the Empire.</td>
</tr>
</tbody>
</table>

## 11th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1002</td>
<td></td>
<td>Byzantine conquest of Bulgaria: Byzantine forces invaded Bulgaria.</td>
</tr>
</tbody>
</table>
1014  |  29 July  |  **Battle of Kleidion**: Basil dealt a decisive and bloody defeat to Bulgarian forces in the Belasica near Klyuch.

1018  |  |  **Byzantine conquest of Bulgaria**: The Bulgarian boyars accepted the establishment of the theme of Bulgaria on the territory of the former Empire, with significant autonomy for themselves.

1025  |  15 December  |  Basil died.

1054  |  16 July  |  **East–West Schism**: The papal legate Humbert of Silva Candida laid on the altar of Hagia Sophia a document proclaiming the excommunication of Michael I Cerularius, the patriarch of Constantinople.

1071  |  15 April  |  **Siege of Bari**: Italo-Norman forces captured Bari, capital of the *katepanikion* of Italy.

26 August  |  |  **Battle of Manzikert**: The Byzantine Empire was decisively defeated by a Seljuk force near Malazgirt. The *basileus* Romanos IV Diogenes was captured.

1081  |  1 April  |  Nikephoros III Botaneiates was deposed and replaced as *basileus* by Alexios I Komnenos.

1091  |  29 April  |  **Battle of Levounion**: The Byzantine army dealt a bloody defeat to a Pecheneg invasion force.

1097  |  19 June  |  **Siege of Nicaea**: The Rum occupants of Nicaea surrendered to Byzantine and First Crusader forces.

1098  |  |  Following the conquest of Antioch, the First Crusader leader Bohemond I of Antioch declared himself prince of Antioch.

**12th century**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1118</td>
<td>15 August</td>
<td><strong>Reign of John II begins</strong>: Being considered the greatest Komnenoi emperor, he starts extensive damage control.</td>
</tr>
<tr>
<td>1122</td>
<td></td>
<td><strong>Battle of Beroia</strong>: A Byzantine army wiped out the Pechenegs at Stara Zagora.</td>
</tr>
<tr>
<td>1124</td>
<td></td>
<td><strong>War with Venice begins</strong>: Over the non-renewal of trading privileges by John II Komnenos.</td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>------</td>
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<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>1126</td>
<td></td>
<td><em>The war with Venice ends in defeat:</em> The Venetian fleet ravaged the coasts of Greece, forcing the emperor to back down.</td>
</tr>
<tr>
<td>1127</td>
<td></td>
<td><em>Hungarians invade the Empire:</em> Invaders go far south as Philippolis.</td>
</tr>
<tr>
<td>1129</td>
<td></td>
<td>Invading Hungarians are repelled</td>
</tr>
<tr>
<td>1136</td>
<td></td>
<td>John II launches his first serious campaign in the east.</td>
</tr>
<tr>
<td>1137</td>
<td></td>
<td>John II conquers the Armenian Kingdom of Cilicia.</td>
</tr>
<tr>
<td>1139</td>
<td></td>
<td>John II vassalizes the Principality of Antioch.</td>
</tr>
<tr>
<td>1143</td>
<td></td>
<td><em>Death of John II:</em> his death marks the beginning of straight decline.</td>
</tr>
<tr>
<td>1146</td>
<td></td>
<td><em>Sack of Philomelion:</em> Under the orders from Manuel I, before relocating the Christian population.</td>
</tr>
<tr>
<td>1167</td>
<td>8 July</td>
<td><em>Battle of Sirmium:</em> Byzantium decisively defeated a Hungarian force at Sirmium.</td>
</tr>
<tr>
<td>1176</td>
<td>17 September</td>
<td><em>Battle of Myriokephalon:</em> A Byzantine invasion force was ambushed and forced to retreat through a mountain pass by Rum near Lake Beyşehir.</td>
</tr>
<tr>
<td>1180</td>
<td>24 September</td>
<td>Basileus Manuel I Komnenos died.</td>
</tr>
<tr>
<td>1185</td>
<td>26 October</td>
<td><em>Uprising of Asen and Peter:</em> A tax revolt began in Paristrion which would result in the establishment of the Second Bulgarian Empire.</td>
</tr>
</tbody>
</table>

**13th century**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1204</td>
<td>13 April</td>
<td><em>Siege of Constantinople (1204):</em> Fourth Crusaders breached and sacked Constantinople, deposed the <em>basileus</em> Alexios V Doukas and established the Latin Empire under their leader Baldwin I, Latin Emperor as Latin Emperor. Theodore I Laskaris was acclaimed <em>basileus</em> but forced to flee with his court to establish the Empire of Nicaea at Nicaea.</td>
</tr>
<tr>
<td></td>
<td>April</td>
<td>Alexios I of Trebizond, a grandson of the former <em>basileus</em> Andronikos I Komnenos, declared himself ruler of Trebizond.</td>
</tr>
</tbody>
</table>
Michael I Komnenos Doukas, a descendant of Alexios I Komnenos, established himself as despot of Epirus.

The Nicaean ruler Michael VIII Palaiologos conquered Constantinople.

Michael was crowned \textit{basileus} in Constantinople along with his infant son Andronikos II Palaiologos.

### 14th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1326</td>
<td></td>
<td>\textit{Byzantine–Ottoman Wars}: The Ottoman Empire conquered Bursa.</td>
</tr>
<tr>
<td>1331</td>
<td></td>
<td>\textit{Byzantine–Ottoman Wars}: The Ottoman Empire captured Nicaea.</td>
</tr>
<tr>
<td>1341</td>
<td>26 October</td>
<td>\textit{Byzantine civil war of 1341–47}: The regent John VI Kantakouzenos was declared \textit{basileus} by his supporters in opposition to the young John V Palaiologos.</td>
</tr>
<tr>
<td>1347</td>
<td>8 February</td>
<td>\textit{Byzantine civil war of 1341–47}: John VI concluded an arrangement under which he would rule as senior \textit{basileus} alongside John V for ten years.</td>
</tr>
</tbody>
</table>

### 15th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1453</td>
<td>29 May</td>
<td>\textit{Fall of Constantinople}: Ottoman forces entered Constantinople. \textit{Basileus} Constantine XI Palaiologos was killed.</td>
</tr>
</tbody>
</table>

### Timeline of ancient Greece

#### Archaic Greece

**Archaic Period (800 BCE – 481 BCE)**

- 785 Pithecusae (Ischia) is settled by Euboean Greeks from Eretria and Chalcis
- 777 Cumae is founded by Chalcis
- 776 Traditional date for the first historic Olympic games.
- 757 The First Messenian War starts. (Date disputed by Jerome, Pausanias and Diodorus; this estimate is based on a reading of Diodorus' Spartan king lists and Pausanias' description of the war).
- 757 Athens: Office of Archon reduced to 10 years. Members of the ruling family to possess the office starting with Charops. (Dating based on Pausanias).
- 756 Kyzikus is settled by Ionians
- 754 Polydorus becomes king of Sparta.
- 743 Rhegion is founded by Euboeans
- 740 Zancle is founded by Euboeans
- 738 Alternate date for the end of the First Messenian War.
- 737 Rhegion and Zancle join in union under Zancle
- 735 Perdiccas I of Macedon flees from Argos to Macedonia and conquers the land.
- 734 Polydorus sends colonists to Italy.
- 734 Syracuse is founded by Korinthians and Teneans
- 734 Kerkyra is founded by Korinthians
- 733 Naxos (Sicily) is founded by Euboeans
- 733 Troliton is founded by Megarans
- 732 Euboea splits between Chalcis and Eretria due to disputes
- 731 Sigeion is founded by Mytilene
- 731 Catania is founded by Chalcidians
- 730 Leontini is founded by Naxos and controlled by the tyrant Euarchus
- 730 Troliton is abandoned and settlers settled in Leontini
- 728 Troliton settlers are ostracized from Leontini and settle Thapsos
- 727–717 Hippomenes, archon of Athens, kills his daughter's adulterer by yoking him to his chariot and then locks his daughter in with a horse until she dies. (Pausanias and Aristotle).
- c. 725 Lelantine War between Chalcis and Eretria. Many Greek cities are allied with one or the other. Dates before this time uncertain.
- 725 Thapsos abandoned and Megara Hyblaea is settled by the Thapsos settlers
- 720s/710s Droughts on Euboea
- 720 Korinth removes the Liburnians from Kerkyra
- 720: Sybaris is founded by Achaeans from Helice
- 719 Polydorus, King of Sparta, is murdered by Polymarchus.
- 716 Mylae is founded and annexed by Zancle
• 716 According to legend: The reign of the Heraklids over Lydia is ended when Candaules, known as Myrsilus to the Greeks, is murdered by Gyges because of his wife's anger.
• 715 Lydia annexes Colophon and Magnesia and sieges Smyrna
• 712 Lydia abandons the siege of Smyrna and annexes parts of Troad and Sipylus
• 712 Korinth annexes Perachora peninsula from Megara
• 710s Eretrian abandonment of Andros
• 709 Kroton is founded by Achaeans
• 707 Taras is founded by Doriains
• 705 Hybla Minor is annexed by Megara Hyblaea
• 704: Korinth gives Samos 4 ships
• 700 Phaselis is founded by Rodians
• 700 Erythra is annexed by Rhedion
• 699 Metapontion is founded by Kroton and Sybaris
• 698 Euarchus is overthrown by Leontini
• 696 Lefkandi is occupied by Chalcis
• 695 Polieum is founded by Ionians
• 691 Antandrus is founded and annexed by Mytilene
• 690 Pheidon becomes tyrant of Argos.
• 689 Gela is founded by Cretans and Rodians
• 688 Arisba is annexed by Methymna and Mytilene declares war on Methymna
• 687 Annual office of Archon established in Athens. Any Athenian citizen can be elected to the office if they have the qualifications. Creon elected first annual archon. (Dating based on Pausanias).
• 686 Methymna is annexed by Mytilene
• 686 Megara gains independence from Korinth
• 685 The second Messenian war begins.
• 685 Chalcedon is founded by Megarians
• 680 Epizephyrian Lokros is founded by Opos
• 676 Pergamon is founded by Ionians
• 674 Karystus is occupied by Korinth
• 672 Abydos is settled by Miletus
671 Melia is destroyed by Samos and Priene, Samos builds Fort Carium to replace it and Samos and Priene split Melia
670 Miletus is sieged by Lydia, Priene is annexed by Lydia, Samos annexes former Melian territory
669 or 668 Battle of Hysiae
668 Lydia abandons siege of Mietus
667 Byzantium is founded by Korinthians
665 The second Messenian war ends.
664 Corcyran Revolt and First Sea Battle in Ancient Greece between Corcyra and Korinthos
664 Akrai is founded and annexed by Syracuse
657 Cypselus subjects Corinth to tyranny.
657 Founding of Lekas by Corinth
655 Akanthus and Stageira are founded by Androsi
654 Abdera is founded by Klazomenaietes
652 Ephesus and Priene are sacked by Cimmerians
651 Levantine War ends, Chalcis wins and annexes Levantine Plain
650 The Pontic Pentapolis: Apollonia, Callatis, Mesembria (Nessebar), Odessos (Varna), and Tomis (Constanta), all on the Euxeinos Pontos.
650 Andros, Kea and Tenos gain independence from Eretria, Cypselus leaves Karystus
650 Syracuse annexes Pantalica
648 Himera is founded by Zancleans
645–630 Spartan wars with Tegea all unsuccessful
643 Kasmenai is founded and annexed by Syracuse
637–630 Drought on Thera
633 Ambrakia founded by Tyrant Gorgus and Korinthians
632 Cylon, Athenian noble, seizes Acropolis and tries unsuccessfully to make himself king
631 Battus establishes a Greek colony in Cyrene in Libya.
630 Helorus is founded and annexed by Syracuse
630 Histria is established by Milesian settlers in order to facilitate trade with the native Getae.
630 Founding of Tripolis by Samos
630 Formal pederasty is introduced, first in Crete, as a means of population control and an educational modality.
- 628 Selinus is founded by Hyblaea Megarans
- 627 Epidamos is founded by Kerkyreans
- 627 Cypselus is succeeded by Periander
- 625 Establishment of Naucratis
- 621 Draco, Athenian lawgiver, issues code of laws, with many crimes punishable by death.
- 621 Epidaurus is annexed by Korinth
- 619 Herbesus is annexed by Syracuse
- 616 Miletus is sieged by Lydia
- 615 Leontini is overthrown by Panaetius
- 612 Miletus is overthrown by Thrasylulos
- 610 Pantikapaeum (modern city Kerch) is founded by Milesians
- 609 Panaetius is oust by Leontini
- 606 Gorgus is succeeded by Periander
- 604 Lydia abandons the Siege of Miletus
- 603 Athenai annexes Sigeion
- 601 Miletus and Korinth become allies
- 600 Massalia founded by Phocaean Greeks (approximate date).
- 600 Segesta is hellenized by Ionians
- 598 Akrillai is founded and annexed by Syracuse
- 598 Kamarina is founded and annexed by Syracuse
- 597 Delphi gains independence from Kirrha
- 596 Paleopoli is founded by Samosi
- 595 Salamis is annexed by Athens
- 595 Start of the First Sacred War
- 594 Kirrha is sieged by Amphictyonic League
- 594 Solon, Athenian statesman, becomes Archon pre-582BCE (cf. ML6 and Plutarch Sol. 14)—later, when member of the Areopagus is appointed to effect social reforms in order to preserve order in Athens, which include the abolition of the security of debts on a debtor's person (Aristotle Ath. Pol. 6), returning exiled Athenian slaves (Solon fr. 4 in Ath. Pol. 12), changing the value of weights and measures to the Korinthian standard, prohibiting the export of grain from Attica and encouraging the planting of olives (Plut. Sol. 22-4), established the property classes (Ar. Ath. Pol. 7) and the council of 400 (Ar. Ath. Pol. 8).
- 592 Ephesus is sieged by Persia
590 Siege of Ephesus is abandoned, Lydia annexes Smyrna and Median-Lyidian war starts
590 Muorica (Renamed Modica) is annexed by Syracuse
590 Sappho, Greek poet, flourishes on island of Lesbos.
589 Klazomenai is sieged by Lydia
588 Poseidonia is founded by Sybaris
587 Siege of Klazomenai is abandoned by Lydia
586 Death of Lycophron tyrant of Corcyra
586 Plataea gains independence from Thebai
585 Kirra is destroyed
585 Lydian-Median border set at Halys River
585 The philosopher Thales of Miletus predicts a solar eclipse that occurs during the Battle of Halys.
585 Periander is overthrown by Psammetichus
585 End of the First Sacred War
585: Destruction of Kirra
583 Psammetichus is overthrown by Korinth
582 Akragas is founded by Gelans
582: First recorded Pythian Games
581 Selinus attacks Motya
581 Korinth join the Peloponnesian League
580 Foundation of Parthenope
580 Selinus is defeated by Carthage and withdraws from Motya
580 Periander is overthrown by democrats in Ambrakia
580 Elis joins the Peloponnesian League
580 Lipari is founded by Knidosi
578 Thrasybulos dies
575 Empúries, also known as Ampurias (Greek: Ἐμπορίων, Catalan: Empúries [əmˈpiriəs], Spanish: Ampurias [amˈpurjas]), a town on the Mediterranean coast of the Catalan comarca of Alt Empordà in Catalonia, Spain is founded by Greek colonists from Phocaea with the name of Ἐμπορίων (Emporion, meaning "trading place", cf. emporion).
572 Pisa and Olympia are annexed by Elis
570 Akragas is overthrown by Phalaris
• 570 Phocaean from Massalia (modern day Marseille) founded the colony of Monokos (Monaco).
• 569 Pythagoras is born.
• 565 Peisistratos, Athenian general, organizes Diakrioi, party of poor people.

Late Archaic Period

• 561 Peisistratos takes power in Athens for first time.
• 560 Ephesus is besieged by Lydia
• 560 Phalaris annexes Himera
• 559 Ephesus is annexed by Lydia
• 559-550 Lydia annexes Aeolis and Ionia
• 559 Achilleion is founded and annexed by Mytilene
• 557 Argos is overthrown by Perilaus
• 556 Phlius is overthrown by Leo
• 555 Helike (Elche) is established by Greeks from the Achaian city of Helice
• 555 Peisistratos driven out by Lycurgus who is commander of nobles.
• 555 Miltiades I unites Thracian Chernessos under his rule
• 554 Phalaris is overthrown by Akragas and Himera gains independence
• 553 Kamarina declares independence from Syracuse
• 552 Kamarina is annexed by Syracuse
• 551 Telemachus overthrows Akragas
• 550 Minoa is founded by Selinus
• 550 Odessa is established by the Greek city of Histria.
• 550 Miltiades II is born
• 549 Peisistratos restored by help of Megacles.
• 549 Boeotian League is founded
• 548 Lesbos sieges Sigeion
• 547 Athens repulses the Lesbans and Sigeion (Now ruled by Hegesistratos) becomes an Athenian vassal
• 546 Sparta annexes Kynouria, Thyrea and Kythera from Argos
• 546 Croesus, rich king of Lydia, captured at Sardis by Persians.
• 545 Miletus is overthrown by Molpogoras
• 545 Lygdamis becomes Tyrant of Naxos
545 The ancient Greek colony of Hermonassa (Krasnodar Krai, Russia) is founded by Ionians and Cretans.
544 Abdera starts its Golden Age
543 Phanagoria, (Krasnodar Krai, Russia), is founded by Teian colonists who had to flee Asia Minor in consequence of their conflict with Cyrus the Great.
542 Peisistratos expelled, makes fortune from Thracian mines.
542 The colony of Gorgippia (Krasnodar Krai, Russia) was built by Pontic Greeks.
541 Telemachus is overthrown by Alcamenes
540 Naxan vassalization of Paros
540 Selinus is overthrown by Theron
538 Sybaris conquers Siris
538 Samos is overthrown by Polycrates
536 Samos annexes South Mycale from Miletus
535 Perilaus dies
534 Athens starts extracting tribute from Ios
532 Croton is overthrown by Cylonius
532 Peisistratos restored by Thessaly and Lygdamis of Naxos.
531 Ikaria is annexed by Samos
530 Emporion becomes a Carthaginian vassal
530 Maktorion is founded by exiled Gelans
530 Tegea joins the Peloponnesian League
529 Leo dies
528 Maktorion is abandoned and the settlers move to Gela
527 Peisistratos dies, succeeded by sons Hippias and Hipparchus.
527 Rineia and Delos are annexed by Samos
526 Cylonius is overthrown by Kroton
525 Netum is annexed by Syracuse
525 The ancient Greek city of Euesperides, (modern day Benghazi) is founded by people from Cyrene
525 Persian Cambyses II, son of Cyrus the Great takes Egypt.
524 Samos annexes Donousa
524 Lygdamis of Naxos is overthrown
523 Chalcedon is annexed by Persian Empire
522 Death of Polycrates of Samos and succession of Maiandrios
521 Overthrow of Maiandros by Persian backed Syloson
520 Peithagoras overthrows Theron
519 Plataea leaves the Boeotian League and is sieged by the latter
519 Miltiades is overthrown by Stesagoras
519 Abydos declares independence from Stesagoras and is led by the Persian Tyrant Daphnis
518 Athens repulses the Boeotians from Plataea
517 Sybaris is overthrown by Telys
516 Miltiades II an Athenian Tyrant succeeds Stesagoras and reincorporates Abydos
516 Cassaibile is annexed by Syracuse
515 Molpadoras is succeeded by Histiaeos
515 Hippias becomes sole ruler after the death of Hipparchus.
514 Tenedos, Lesbos and Abydos is annexed by Persian Empire
513 Miltiades II defects from Athens to Persia
513 Myrcinos is founded by Ionians
513 Persia annexes Thrace (Region)
513 Cinyps, Libya, a failed Greek attempt to build a city under the leadership of Dorieus.
512 Antandrus is annexed by Persian Empire
512 Persian vassalization of Naxos
511 Piraeus is founded and annexed by Athens
511 Thracian Chersonessos is annexed by Persian Empire
510 Kroton annexes Sybaris and overthrows Telys
510 Pythagoras establishes his own school.
510 Peithagoras is overthrown by Euryleon
510 Minoa is renamed Heraclea Minoa
510 Cinyps is annexed by Carthage
508 Andros and Naxos are annexed by Persian Empire
508 Hippias is forced to leave Athens.
507 Plataea is sieged by Boeotian League
507 Cleisthenes, Greek reformer, takes power, increases democracy.
506 Boeotian League is repulsed from Plataea by Athens
506 Cumae is overthrown by Aristodemus
506 Alcamenes is overthrown by Alcandros
506 The Levantine Plain is conquered by Athens and becomes a Cleurchy
505 Hegesistratos of Sigeion dies
505 Cleander overthrows Gela
504 Cleinias overthrows Croton
504 Taras defeats the Iapygians
503 Naxos declares independence from the Persian Empire
502 Euryleon is overthrown by Selinus
500 Pythagoras dies in Croton, Italy, when he was in Metapontum?
500 Heraclea Minoa is sacked by Carthage
500 Morgantina and Centuripe are hellenized and Licodia is founded by Leontini
499 Miletus Siege of Naxos (Naxan Victory)
499 Independence of Paros
499 Alcandros is overthrown by Akragas
499 Ionian Revolt starts
499 Éphesos, Klazomenai, Milêtos, Samos, Myus, Chios, Samos, Mytilene, Mylasa, Termera, Kyme and Priene declare independence from Persian Empire
498 Cyprus (Except Amathos), Caria, Paesos, Abydos, Cios, Percote, Lampsakos, Myrcinos, Tenedos, Dardanos, and Byzantium declare independence from Persian Empire
498 Amathos is sieged by Cyprus
498 Cleander is overthrown by Hippocrates
498 Hippocrates vassalized Leontini and puts Aenesidemus as tyrant
498 Licodia is annexed by Syracuse
497 Eion is sieged by Athens
497 Dardanos, Myrcinos, Abydos, Kyme, Klazomenai, Percote, Lampsakos, Cyprus, Cios and Paesos are reannexed by Persian Empire
497 Catania is vassalized by Hippocrates and Deinmenes is put in charge as tyrant
497 Persian Empire occupies all Carian land north of Pedasos (Carian)
496 Byzantium is overthrown by Histiaeos
496 Myrcinos is reannexed by the Persian Empire
496 Athenian Tyrant Miltiades II annexes Thracian Chersonnos
496 Naxos is vassalized by Hippocrates
495 Cleinias dies
494 Rhetium is overthrown by Anaxilas
494 Zancle is vassalized by Hippocrates and Scythes put in charge
494 Priene, Samos and Miletus are annexed by Persian Empire
493 Byzantium sieges Thasus
493 Ionian revolt crushed
493 Zancle is settled by Samian refugees and renamed Messene
493 Zancle is conquered by Rhegium
492 Kamarina (now rebuilt) and Ergezio [it] are vassalized by Hippocrates
492 Abdera and Thracian Chersonnos are annexed by the Persian Empire
491 Hippocrates is overthrown by Gelon
491 Fort Scyllaeum is founded by Rhegium
490 Aristodemus dies
490 Persian conquest of Rhodes
490 Persian Siege of Naxos (Naxan Victory)
490 Persian conquest of Paros
490 Persian sacking of Eretria
490 Themistocles and Miltiades, Athenians, defeat Darius at Marathon, Phidippides runs with news.
490 Taras defeats the Iapygians in battle
488 Akragas is overthrown by Theron
486 Himera is overthrown by Terillus
485 Gelon annexes Syracuse (Except Kamarina and Licodia), Gela is given to Hieron
484 Kamarina is destroyed by Gelon
484 Aeschylus, Athenian playwright wins his first victory at the City Dionysia.
483 Megara Hyblaea and Licodia are destroyed by Gelon
483 Theron puts his son Thrasydaeus in charge of Himera as his vassal
481 Andros, Aegina and Akanthus among many other Greek Poleis declare allegiance to Persia
481 The Naxos, Milos, Sparta, Athens, Korinth, Kythnos and many other Greek Poleis form the Hellenic League to fight against the Persian Empire
Classical Greece

Classical period (480 BC – 323 BC)

- 480 Aegina and Andros are impressed into the Hellenic League
- 480 Emporion ousts Carthaginian influences
- 480 Leonidas, Spartan, sacrifices 300 Spartan soldiers at the Battle of Thermopylae so main force can escape; Xerxes son of Darius is commanding the Persians.
- 480 Croton, Leucas and Corcyra joins the Hellenic League
- 480 Simultaneous with Thermopylae, the Greeks and Persians fight to a draw in the naval Battle of Artemision.
- 480 Boeotia, Attica and Phocis are occupied by Persia
- 480 Battle of Salamis: Themistocles, Athenian general, lures Persians into Bay of Salamis, Xerxes loses and goes home, leaves behind Mardonius.
- 480 Possibly simultaneous with the Battle of Salamis, Battle of Himera between Carthage and Akragas (Theron)-Syracuse (Gelon)-Himera (Thrasydaeus)
- 479 Pausanias, Greek general routs Mardonius at the Battle of Plataea.
- 479 Battle of Mycale
- 479 Rhodes, Samos, Kos and many Greek cities in Persia begin to declare independence
- 479 Paros is vassalized by Athens
- 479 Athens annexes Tenedos
- 479 Sestos is sieged by Athens
- 479 Boeotian League is dissolved by Hellenic League
- 479 Sicel Ducetius overthrows Miniu
- 478 Byzantium is sieged by Athens
- 478 Delian League is founded by Athens and is soon joined by Ionia, Delos, Kos, Euboea, Tilos, Rhodes, Karpathos, Athenai, Paros, Troezen, Sifnos, Doris, Aeolis, Andros, Aenea, Akanthos, Samos, Chalcis, Eretria, Chios, Methymna, Chalkidiki, Mutilênê, Sigeion, Éphesos and many others
- 478 Gelon dies and is succeeded by Hieron, Polyzelos is put in control of Gela
- 477 The Persian Empire abandons Europe except Doriskus and Eion
- 477 Chalcedon, Byzantium, Carystus, Ainos, Perinthos and others join the Delian League
- 477 Andros is turned into an Athenian cleurchy
- 476 Micythus becomes Tyrant of Rhegion after Anaxilas' death
- 476 Catania is split between Hieron and Ducetius, Catania is renamed Aetna, settled by Doriens and ruled by the Tyrant Deinmenes II
- 476 Taras allies with Rhegion to protect themselves from the Iapygians, but later lose to them in battle
- 476 Himera is settled by Doric colonists
- 476 Sybaris declares independence from Kroton
- 476–462 Cimon elected general each year
- 475 Sybaris is annexed by Kroton
- 475 Abdera and Eion join the Delian League
- 475 Skyros is annexed by Athens
- 474 Battle of Cumae
- 474 Naxos joins the Delian League
- 474 Hieron occupies the Parthenopean Islands
- 474 Pindar, Greek poet relocates to Thebes (in Greece) from court at Syracuse.
- 473 Taras is defeated by the Iapygians
- 472 Thrasydaeus annexes Akragas after death of Theron
- 471 Naxos leaves the Delian League and is subsequently sieged by Athens
- 471 Themistocles ostracized.
- 470 Dénia, Hēmeroskopeion (Ancient Greek: Ἦμεροσκοπεῖον) is founded by Massaliot Greeks. The town was situated on the cape then called Artemisium (Ancient Greek: Ἀρτεμίσιον) or Dianium (Ancient Greek: Διάνιον), named from a temple of Ephesia Artemis built upon it (goddess Artemis was called Diana in Latin).
- 470 Naxos is impressed into the Delian League
- 470 Ducetius annexes Ergezio
- 470 The new urban zone of Neápolis (Νεάπολις) was founded by citizens of the nearby Greek city of Cumae on the plain of Parthenope after the victorious Battle of Cumae
- 469 Illios is annexed by Mytilene
- 469 Klazomenai, Phaselis, Aspendos, Doris and Priene join the Delian League
- 468 Thrasydaeus is overthrown by Akragas
- 468 Sophocles, Greek playwright, defeats Aeschylus for Athenian Prize for drama.
- 467 Micythus steps down to Leophron
- 466 Taras is defeated by the Iapygians
- 466 Taras' monarchy is overthrown by democrats
- 466 Thrasybulos succeeds Hieron
- 465 Thasus leaves the Delian League and is sieged by Athens
- 465 Abydos and Troad join the Delian League
- 465 Thracian Chersonesus is annexed by Athens
- 465 Deinmenes II, Aenesidemus, Thrasybulos and Polyzelos are overthrown by their respective cities
- 463 Thasus is impressed into the Delian League
- 462 Megara leaves the Peloponnesian League
- 461 Catania, Naxos and Catania declare independence from Syracuse, Dorian settlers are removed from Catania
- 461 Kamarina is refounded under the Tyranny of Psaumis
- 461 Cimon ostracized.
- 461 Thera joins the Peloponnesian League
- 461 Messene and Rhetion separate and oust Leophron
- 460 Taras defeats the Iapygians
- 460 Aetna is founded
- 460 First Peloponnesian War starts
- 459 Aegina is sieged by Athens
- 459: Morgantina is annexed by Ducetius
- 459-455 Siege of Memphis, destruction of the Athenian fleet by Megabyzus
- 458 Imbros is annexed by Athens
- 457 Aegina is impressed into the Delian League
- 457 Delphi is annexed by Phocis
- 457 Pericles, Athenian statesman begins Golden Age, he was taught by Anaxagoras, who believed in dualistic Universe and atoms.
- 457 Boeotia (Except Thebes), Phocis and Locris join the Delian League
- 456 Gythium is raided by Athens
- 456 Zakynthos joins the Delian League
- 456 Castrugiuvanni (Enna) join Ducetius
- 456 Aeschylus dies.
- 455 Nafpaktos is impressed into the Delian League and settled with Messenian Helots
- 454 Abacaenum is annexed by Ducetius
• 454 Movement of Delian treasury to Athens and start of the First Athenian Empire
• 454 Athenian annexation of Delos
• 453 Palike is founded by Ducetius
• 452 Akragas and Aetna are annexed by Ducetius, Ducetius sieges Motyon
• 452 Nea Sybaris is founded by Sybarites
• 451 Athens sieges Kition
• 451 Motyon is occupied by Ducetius
• 450 Naxos becomes a cleurchy
• 450 Akragas and Motyon are liberated from Ducetius starting a decades long conflict between Syracuse+friends and the Sicels
• 449 Delphi declares independence from Phocis
• 449 Ducetius abandons the Sicel Federation he created and is forced to go into exile at Korinth
• 449 Morgantina is annexed Syracuse
• 449 Herodotus, Greek Historian, writes History of Greco-Persian War from 490–479.
• 448 Delphi is annexed by Phocis
• 447 Ictinus and Callicrates, Greek architects, begin construction of the Parthenon.
• 447 Nea Sybaris is annexed by Kroton
• 447 Chalcis leaves the Delian League and is sieged by Athens
• 446 Phocis, Locris and Boetia leave the Delian League, Boetia unites into the Boeotian League and joins the Peloponnesian League
• 446 Megara joins the Peloponnesian League
• 446 Kale Akte is founded by Ducetius
• 446 Achaia and Trozen leave the Peloponnesian League and join the Delian League
• 446-445 Euboean Revolt
• 445 Euboea is impressed into the Delian League
• 445 Histiaea becomes an Athenian cleurchy
• 445 First Peloponnesian War Ends
• 445 Troezen is impressed into the Peloponnesian League
• 443 Thurii is founded by Sybarites and Various Hellenes
• 441 Euripides, Greek playwright, wins Athenian prize.
• 441 Sybaris on the Traeis is founded by Sybarites exiled from Thurii
- 440 Samos leaves the Delian League and is sieged by Athens
- 440 Palike is destroyed, ending the Sicel Federation
- 440 Ducetius dies
- 439 Samos is impressed into the Delian League
- 438 Founding of the Bosporan Kingdom
- 437 Newly founded Amphipolis annexes Eion
- 437 Athens allies with Messapia
- 436 Taulantii-Epidamos War
- 435 Phidias, Greek sculptor, completes statue of Zeus at Elis, 1 of 7 wonders of the world.
- 434 Epidamos becomes a democracy
- 434 Epidamos is annexed by Korinth
- 434 Kerkyra allies with Taulantii and siege Epidamos
- 434 Kerkyra seizes Outer Epidamos (City)
- 434 Battle of Leukimme
- 434 Kerkyra raids Kyllene
- 434 Kerkyra joins Delian League
- 433 Battle of Sybota
- 433 Anactorium is annexed by Korinth
- 432 Psaumis dies
- 432 Potidæa leaves the Delian League and is sieged by Athens
- 432 Pydna is sieged by Athens
- 432 End of "Golden Age" of Athens
- 431 Sparta commanded by King Archidamus II prepares to destroy Athens thus starting the Peloponnesian War.
- 431 Plataea is sieged by Thebes
- 431 Pagæ and Atalanta is occupied by Athens
- 431 Aegina is annexed by Athens
- 431 Empedocles, Greek doctor, believes body has Four Temperaments.
- 430 Athens abandons the Siege of Pydna
- 430 Herakleion is impressed into the Delian League
- 430 Spartan Siege of Zakynthos (Local Victory)
430 Failed peace mission by Athens, bubonic plague year, Sparta takes no prisoners.
430 Leucippus, Greek philosopher, believes every natural event has natural cause. Athenian Plague begins in Athens.
429 Herakleion is annexed by Macedonia
429 Potidaea is impressed into the Delian League
429 All Chalkidiki cities (Except Mende, Acanthus, Scione, Stagirus and Aphytis) leave the Delian League
429 Athens Siege of Kydonia (Local Victory)
429 Phormio, Athenian admiral, wins the Battle of Chalcis/Rhium.
429 Pericles dies of Athenian Plague, possibly typhus or bubonic plague.
429 Hippocrates, Greek doctor, believes diseases have physical cause.
429 First Battle of Naupaktos (Athenian Victory)
428 Plato born.
428 Mytilene and Antissa leave the Delian league and Mytilene is sieged by Athens, Antissa is sieged by Methymna
428 Illios joins the Delian League
427 Suppression of Mytilene, Antissa is annexed by Methymna, Mytilene becomes an Athenian Cleurchy, Mytilene Troad joins the Delian League as independent cities
427 Archidamus II dies, Alcidas, Greek admiral sent to help Lesbos, raids Ionia and flees after seeing Athenian might. Athenian Plague returns.
427 Plataea is impressed into the Boeotian League and by extension, the Peloponnesian League
427 Aristophanes, Greek playwright, wins Athenian Prize.
427 Corcyran Civil War (Democratic Victory)
427 First Athenian Intervention in Sicily begins
426 Megara occupies Pegae
426 Athens sieges Lecus
426 Pylos, Messene, Mylae, Aegitium and Tichium are occupied by Athens, Pylos is founded by escaped Helots
426 Battle of Tanagra
426 Amfissa joins the Peloponnesian League
426 Ozolian Locris join the Delian League
426 Demosthenes, Athenian general, and Cleon, Athenian demagogue, revitalizes Athenian forces, makes bold plans opposed by Nicias, his first military campaign barely succeeds.
- 426 Ambrakia occupies Olpae and Argos
- 426 Acarnanian League and Amphilochnian League are founded and join the Delian League
- 425 Acarnania occupies Olpae and Argos
- 425 Athenian fleet bottles up Spartan navy at Navarino Bay, Nicias resigns.
- 425 Herakleion is impressed into the Delian League
- 425 Athens occupies Sphacteria
- 425 Morgantina is annexed by Kamarina
- 425 Ozolian Locris joins the Peloponnesian League
- 425 Athens withdraws from Lecas and Acarnania
- 425 Athens withdraws from Messene and Mylae is impressed into the Delian League
- 424 Herakleion is annexed by Makedonia
- 424 Eion, Akanthus and Amphipolis are sieged by Sparta
- 424 Stagira joins the Peloponnesian League
- 424 Nisaia, and Siphæ are occupied by Athenai
- 424 Thyrea is occupied by Athens
- 424 First Athenian Intervention in Sicily ends
- 424 Pagondas of Thebes (in Greece) crushes Athenian army at the Battle of Delium, Brasidas a Spartan general, has a successful campaign in the Chalcidice, Cleon exiles Thucydides for 20 years for arriving late.
- 423 Sparta occupied Amphipolis and Scione
- 423 Torone is occupied by Makedonia
- 423 Akanthus joins the Peloponnesian League
- 423 Truce of Laches supposed to stop Brasidas but doesn't, Nicias commands Athenian forces in retaking Mende.
- 423 Olynthus form the Chalcidian League independent of the Delian League
- 422 Stagira is sieged by Athens
- 422 Neapolis is annexed by Rome
- 422 Torone and Scione are impressed into the Delian League
- 422 Cleon meets Brasidas outside of Amphipolis, both are killed (Battle of Amphipolis).
- 422 Syracuse annexes the now weak Leontini
- 421 Peace of Nicias brings temporary end to war, but Alcibiades, a nephew of Pericles, makes anti-Sparta alliance.
- 421 Herakleion is impressed into the Delian League
- 421 Cumae is annexed by Oscans
- 421 Athens abandons the Siege of Stagira
- 421 Delphi declares independence from Phocis
- 421 Argulus, Apollonia, Potidaea, Akanthus, Stageira and others join the Chalcidian League
- 420 Mantinea, Argos, Elis, Sicyon and Achaea betray Sparta and switch to the Delian League
- 419 Athens occupies Epidauros
- 419 King Agis II of Sparta attacks Argos, makes treaty.
- 418 Battle of Mantinea, greatest land battle of war, gives Sparta victory over Argos, which violated treaty, Alcibiades thrown out, alliance ended.
- 418 Orchomenos is occupied by Argos
- 417 Orchomenos is given to Boeotia
- 417 Sicyon joins the Peloponnesian League
- 417 Epidauros is occupied by Sparta
- 416 Melos is sieged by Athens
- 416 Alcibiades makes plans, is restored to power.
- 416 Selinus annexes Segesta's frontier provinces
- 416 Massacre of the Melians.
- 415 Hermai statues are mutilated in Athens, Alcibiades accused, asks for inquiry, told to set sail for battle (Sicilian Expedition), is condemned to death in absentia, he defects to Sparta.
- 415 Many Syracusan cities rebel
- 415-413 Siege of Syracuse
- 414-413 Metapontion allies with Athens
- 414 Lamachus, Athenian commander killed at Syracuse.
- 413 Nicias and Demosthenes killed at Syracuse
- 413 Leontini and Kamarina are vassalized by Syracuse
- 413 Herakleion is annexed by Makedonia
- 413 Miletus and Khios betray Athens and join the Peloponnesian League
- 412 Alcibiades is expelled from Sparta, conspires to come back to Athens.
- 412 Methymna is occupied by Sparta
- 412 Klazomenai and Kyzikus betray Athens and join the Peloponnesian League
412 Chios is sieged by Athens
412 Aygrion dies and is succeeded by Aygris
411 Sparta allies with Persia
411 Aspendos is annexed by Persia
411 Kyzikus and Klazomenai are impressed into the Delian League
411 Oropos is occupied by Boeotia
411 Illios is annexes by Lampasacus
411 Athens abandons the Siege of Chios
411 Sparta leaves Methymna
411 Euboea, Byzantium, Abydos, Andros, Antandrus, Lampasacus, Chalcedon and Rodos betray Athens and join the Peloponnesian League
411 Abydos is overthrown by Dercylidas
411 Selinus attacks Segesta once again and aggravates Carthage
411 Athens is overthrown by the Four Hundred
410 After several successes, Athenian demagogue Cleophon rejects Spartan peace offers.
410 Segesta is annexed by Carthage
410 Four Hundred are overthrown by Athens
409 Antandrus is annexed by Persia
409 Abydos is sieged by Athens
409 Sparta sieges Klazomenai
409 Selinus and Himera are sacked by Carthage
409 Byzantium recaptured by Alcibiades for Athens.
408 The 3 poleis of Rodos unite and build a new capital called Rodos
408 Athens sieges Paleopoli
408 Athens abandons Siege of Abydos
408 Sparta abandons the Siege of Klazomenai
408 Alcibiades reenters Athens in triumph, Lysander, a Spartan commander, has fleet built at Ephesus.
407 Thermae is founded by Carthage
407 Athens abandons the Siege of Paleopoli
407 Lysander begins destruction of Athenian fleet, Alcibiades stripped of power.
406 Sparta sieges Methymna
- 406 Akragas is sacked by Carthage
- 406 Callicratides, Spartan naval commander, loses Battle of Arginusae over blockade of Mitylene harbor, Sparta sues for peace, rejected by Cleophon.
- 405 Methymna is impressed into the Peloponnesian League
- 405 Syracuse is overthrown by Dionysius the Elder
- 405 Melos is annexed by Sparta
- 405 Gela, Kamarina and Akrillai is sacked by Carthage
- 405 Carthage allow the people of the sacked cities to return as Carthaginian subjects and rebuild their cities
- 405 Leontini and Morgantina declare independence from Syracuse
- 405 Carthage annexes Elymi, Sicel and Sican territory
- 405 The naval Battle of Aegospotami in which Lysander captures the Athenian fleet, Spartan king Pausanias besieges Athens, Cleophon executed, Corinth and Thebes demand destruction of Athens.
- 405 Klazomenai and Ephesus betray Athens and join the Peloponnesian League. All Carthaginian subjects (Except Ziz, their islands, Motya, Solus, Elymi, Segesta, and Entella) gain independence
- 404 Athens capitulates April 25. Theramenes secures terms, prevents total destruction of Athens, Theramenes and Alcibiades are killed.
- 404 Delian League is dissolved
- 404 Korinth leaves the Peloponnesian League
- 404 Entella is overthrown by mercenaries loyal to Carthage
- 404 Aygris becomes a Syracusan Subject
- 404 Nafpaktos is annexed by Ozolian Locris
- 404 Athens is overthrown by the Thirty
- 404 Athens joins the Peloponnesian League
- 403 Aeimnestus, who is loyal to Dionysius, overthrows Castrugiuvanni
- 403 Aetna is overthrown by mercenaries loyal to Dionysius
- 403 Dionysius destroys Naxos and Catania and Sicels split Naxos with Syracuse, Catania is ruled by Campanian mercenaries loyal to Dionysius
- 403 Athens overthrows the Thirty
- 403 Athens leaves the Peloponnesian League and refounds the Delian League
- 402 Elis leaves the Peloponnesian League and is subsequently sieged by Sparta
- 401 Euboea joins the Delian League
- 401 Elis is sacked and impressed into the Peloponnesian League
• 401 Dionysius free Castrugiuvanni from Aeimnestus
• 401 Poseidonia is annexed by Lucanians
• 401 Thucydides, Greek historian, leaves account of "Golden Age of Pericles" and Peloponnesian War at his death (History of the Peloponnesian War).
• 400 Adranon is founded by Dionysius
• 400 Aygris annexes Centuripe
• 400 Democritus, Greek philosopher, develops Atomic theory, believes cause and necessity, nothing comes out of nothing
• 399 Illios declares independence from Lampsacus
• 399 Sparta sways Persian Controlled Greek cities near Pergamon to their side and march on Egyptian Larissa and siege it
• 399 Socrates, Greek philosopher, condemned to death for corrupting youth.
• 398 Ionia joins the Peloponnesian League
• 398 All Carthaginian subjects (Except Ziz, their islands, Motya, Solus, Elymi, Segesta, and Entella) gain independence from Carthage
• 398 Dionysius sieges Segesta and Entella
• 398 Mainland territory of Motya is occupied by Dionysius
• 397 Motya is destroyed by Dionysius and the Carthaginians build Lilybaion to replace it
• 397 Dionysius abandons the Sieges of Entella and Segesta
• 397 Eryx, Segesta, Lipari, Messene and Entella are annexed by Carthage
• 397 Carthage allies with the Sicel cities except Assorus
• 397 Tauormenion is founded by Carthage to be a supply base, settled by Sicels
• 397 Carthaginian forces have to go the long way around Mount Etna due to an eruption
• 397 Catania is occupied by Carthage
• 397 Battle of Catania
• 397 Syracuse is sieged by Carthage
• 396 Carthage lifts the Siege of Syracuse and abandons Eastern Sicily except Messene and Lipari
• 396 Himera and Selinus are annexed by Carthage
• 396 Gela, Ergezio, Catania, Adranon, Kamarina and Leontini are annexed by Dionysius
• 396 Tyndaris is founded by Dionysius to combat piracy and a base of operations
• 396 Persia annexes Rodos
• 396 Sparta campaigns in Phrygia
395 Sparta campaigns in Ionia, Caria and march up to Sardis
395 Orchmenus leaves the Boeotian League
395 Cephaloedium is annexed by Dionysius
395 Mylae is annexed by Regin
395 Argos, Korinthos and Boeotian League leave the Peloponnesian League
394 Sparta withdraws from Anatolia
394 All Thracian and Anatolian Greek cities leave the Peloponnesian League (Except Sestos and Abydos)
394 Virtually all Greek Anatolian cities are annexed by Persia
394 Klazomenaiites relocate to an island off shore
394 Mylae is annexed by Syracuse
394 Lipari is annexed by Syracuse
393 Italiote League is formed by Sybaris on the Traeis, Croton, Caulonia, Thurii, Rhegium and Velia
393 Imbros, Lemnos and Skyros are annexed by Athens
393 Makedonia starts paying tribute to the newly formed Kingdom of Dardania
393 Chalcidian League annexes some Makedonian land
392 Sparta occupies Lechaeum
392 Heraclea Minoa, Akragas and Sicani territory are annexed by Carthage
392 Sicel territory is annexed by Dionysius
392 Makedonia stops paying tribute to Dardania
392 Makedonia reannexes the land taken by the Chalcidian League
392 Damastion is annexed by Dardania
391 Korinth occupies Phlius
391 Tauromenion is overthrown by mercenaries loyal to Dionysius
391 Makedonia starts pays tribute to Dardania
390 The Acarnanian League joins the Peloponnesian League
390 Dercylidas is succeeded by Anaxibios
390 Himera is merged into Thermae
390 Dionysius transfers control of Mylae to Messene
390 Kroton is annexed by Syracuse
390 Argos and Korinth unite into Argos-Korinth
390 Castrugiuvani is annexed by Syracuse
• 389 Metapontion is annexed by Syracuse
• 389 Anaxibios is overthrown by Abydos
• 387 Rhegion is annexed by Syracuse and renamed it to Phoebea
• 387 Peace of Antalcidas concluded between the Greeks and the Persians that leads to virtually all Greek cities in Asia Minor being annexed by Persia
• 387 Ancona is founded by Greek settlers from Syracuse, who gave it its name: Ancona stems from the Greek word Ἄγκων (Ἀγκών), meaning "elbow"
• 387 Argos and Korinth split
• 387 All cities gain independence and all league except the Peloponnesian League are disbanded
• 386 Phlius becomes a democracy
• 385 Dardania attacks Molossia
• 385 The Greeks colonized the island of Pharos (Hvar, Croatia).
• 384 Dionysius occupies Pyrgi and Caere
• 384 Chalcidian League annexes Makedonia land including Pella
• 383 Gela gains independence from Syracuse
• 383 Dionysius leaves Eturia
• 383 Liburnia sieges Pharos
• 383 Potidaea leaves the Chalcidian League
• 382 Thebes is overthrown by Leontiades and Archias
• 382 Thebes is impressed into the Peloponnesian League
• 380 Sparta sieges Phlius
• 380 Makedonia recaptures their former territory
• 379 Kroton is annexed by Dionysius
• 379 Phlius is impressed into the Peloponnesian League
• 379 The Chalcidian League is disbanded and its former members are impressed into the Peloponnesian League and Potidaea and Korinth also join the league
• 379 Leontiades and Archias are overthrown and Thebes leaves the Peloponnesian League
• 379 Sparta occupies Thespiae
• 378 Themison overthrows Eretria
• 377 The Boeotian League is refounded by Thebes
• 376 Abdera is sacked by the Triballi and Maroneia
- 376 Thespiae and the rest of Boeotia are liberated and join the Boeotian League
- 375 The Acarnanian League defects from the Peloponnesian League and joins the Delian League
- 375 Chalcidian League is reestablished by Olynthus and joins the Delian League
- 373 Kerkyra is sieged by Sparta
- 371 Sparta leaves Kerkyra
- 370 Gythium is occupied by Thebes
- 370 Heraclea Sintica is founded by Makedonia
- 369 Korinth is overthrown by Timophanes
- 368 Aetolian League is founded
- 367 Daparria is annexed by Dardania
- 367 Kroton is annexed by Bruttian League
- 366 Opus declares independence from Athens with the help of Themison
- 365 Opus requests Thebes to protect them from Athens and sends a garrison. Opus is impressed into the Boeotian League
- 364 Timophanes is assassinated
- 364 Orchmenus leaves the Boeotian League and is subsequently sieged by Thebes
- 363 Orchmenus is impressed into the Boeotian League
- 363 Pydna is impressed into the Delian League
- 362 Themison dies and is succeeded by Plutarch
- 361 Potidaea and Torone are impressed into the Delian League and become Athenian Cleurchies
- 360 Tauromenion overthrows the mercenaries and falls under the tyranny of Andromache
- 360 Illios is overthrown by Charidemos
- 360 Abydos is overthrown by Iphiades
- 359 Charidemos is overthrown by Illios
- 359 Dardania annexes Lake Ohrid and Upper Macedonia
- 359 Archelaus annexes Methone, Aegae and Pydna
- 358 Archelaus is annexed by Makedonia
- 358 Macedonia reannexes Lake Ohrid, Lynkestis and Upper Macedonia from Dardania
- 358 Makedonia annexes Paeonia
- 357 Social War Starts
- 357 Kos, Khios, Rodos and Byzantium leave the Delian League
357 Makedonia annexes Pydna and Amphipolis
357 Dionysius II is overthrown by Dion
356 Phocis annexes Delphi
356 Locris is annexed by Dionysius II
356 Lemnos, Samos and Imbros is occupied by Chios and leave the Delian League
356 Makedonia annexes Crenides, renames it Philippi and settles it with Makedonians
356 Makedonian border set on Nestus river
356 Potidaea and Anthemus are annexed by Chalcidian League
356 Makedonia sieges Methone
356 Lokros is overthrown by Dionysius II
355 Social War Ends
355 Argolas is sieged by Phocis
355 Dion is overthrown by Callipus
354 Methone and Abdera are annexed by Makedonia
354 Phocis abandons the Siege of Argolas
354 Thessaly is vassalized by Phocis
353 Catania is annexed by Callipus
353 Makedonia occupied Pagasae
353 Thessaly is vassalized by Makedonia
352 Callipus is overthrown by Hipparinos (Callipus keeps Catania)
352 Nicodemus overthrows Centuripe
352 Orchmenus and Chaeronea are occupied by Phocis
351 Rhegion is annexed by Callipus
350 Akanthus is annexed by Makedonia
350 Nice (Nicaea) is founded by the Greeks of Massalia (Marseille), and was given the name of Nikaia (Νικαία) in honour of a victory over the neighbouring Ligurians; Nike (Νίκη) was the Greek goddess of victory.
350 Hipparinos is overthrown by Aretaeus
350 Mamercus ousts Callippus from Catania
349 Plutarch is expelled from Eretria
349 Aretaeus is overthrown by Nysaios
- 348 Stagira is annexed by Makedonia
- 348 Callipus is overthrown by Leptines
- 347 Leontini is overthrown by Hicetas
- 347 Plato, Greek philosopher, founder of Academy, dies.
- 347 Methymna is overthrown by Kleommis
- 346 Phocis withdraws from Boeotia
- 346 Dionysius II leaves Locris and overthrows Nysaios
- 345 Makedonia withdraws from Thermopylae and Antikyra
- 345 Grabaei becomes a vassal of Macedonia
- 345 Hicetas sieges Syracuse and seizes Syracuse's territory
- 344 Macedonia occupies Illios and annexes Tenedos
- 344 Rhégion is freed by Timoleon
- 343 Messene is rebuilt by Timoelon, Adranon is freed from mercenary control, Nicodemus is overthrown by Centuripe with help of Timoleon
- 342 Aristotle, Greek philosopher, begins teaching Alexander, son of Philip of Macedon.
- 341 Hipparchus is overthrown by Athenian forces and impressed into the Delian league
- 341 Samothrace is annexed by Makedonia
- 340 Antipolis (modern day Antibes) is founded by Phocaean Greeks from Massilia.
- 340 Skyros is annexed by Makedonia
- 340 Entella is freed by Timoleon
- 339 Elateia is occupied by Makedonia
- 339 Agyris and Aetna are freed by Timoleon
- 339 Nicaea is occupied by Boeotia
- 338 Amphissa is annexed by Delphi
- 338 Thyrea is annexed by Argos
- 338 Mamercus dies
- 338 Cumae is annexed by Rome
- 338 Leontini is freed by Timoleon
- 338 Nafpaktos joins the Aetolian League
- 338 King Philip II of Macedon defeats Athens and Thebes at Battle of Chaeronea August 2 and establishes League of Corinth during winter of 338 BC/337 BC.
- 337 Amfissa declares independence from Delphi
- 336 Timoleon dies
- 336 Lesbos is annexed by Makedonia
- 336 Alexander succeeds father Philip II, who was assassinated by Pausanias of Orestis.
- 334 Andromache dies and his city is annexed by Syracuse
- 334 Battle of the Granicus
- 333 Saminum is occupied by Epirus
- 333 Alexander defeats Persians at Battle of Issus, but Darius III escapes.
- 332 Epirus occupies Heraclea, Metapontium, Southern Lucania, Daunia, Paestum, Terina and Sipontum
- 332 Siege of Tyre
- 332 Siege of Gaza
- 332 Alexander conquers Egypt.
- 332 Alexandria is founded by Alexander the Great
- 331 Epirus occupies Cosentia
- 331 Battle of Pandosia
- 331 Gerasa (Jordan) is founded by Makedonian veterans
- 331 at Battle of Gaugamela October 1, Alexander ends Achaemenid Dynasty and conquers Persian Empire.
- 331 Alexander the Great enters in Babylon
- 331 Tauromenion is freed by Carthage
- 331 Battle of the Uxian Defile (East of Susa, Iran)
- 330 Sparta joins the League of Corinth
- 330 Battle of the Persian Gate, destruction of Persepolis (modern Iran)
- 330-325 Pytheas makes the earliest Greek voyage to Great Britain and the Arctic Circle for which there is a record.
- 329 Siege of Cyropolis
- 329 Battle of Jaxartes
- 329 Alexander conquers Samarkand, Uzbekistan
- 329 Alexander the Great founds Alexandria Eschate in modern Tajikistan
- 329-160 Dayuan Kingdom.
- 328 Sybaris on the Traeis is annexed by Bruttian League
- 327 Oenidae is impressed into the Aetolian League
- 327 Under the command of Alexander the Great the forces of the Hellenic League captures the fortress of the Sogdian Rock. Sogdiana and the Kabul region came under Hellenic control
- 327 Alexander invades northern India, but his army is despondent and refuses to march further eastwards.
- 326 Battle of the Hydaspes
- 326 Samos joins the Delian League
- 326 Alexandria Bucephalous (located on the Hydaspes river, Pakistan) is founded by Alexander the Great in memory of his beloved horse Bucephalus
- 325 Nearchus serving under Alexander the Great discovers Tylos (the name used by the Greeks to refer to Bahrain).
- 324 Kroton is overthrown by Menedemus
- 324 Charax Spasinu, one of Alexander's last cities before his death, is established at the head of the Persian Gulf (modern Iraq) replacing a small Persian settlement, Durine.

**Hellenistic Greece**

**Hellenistic period (323 BC – 146 BC)**

- 323 King Alexander dies, his generals vie for power in Wars of the Diadochi
- 322–320 First War of the Diadochi.
- 320 Partition of Triparadisus.
- 316 Menander, Greek playwright, wins Athenian prize.
- 312–63 Seleucid Empire.
310 Zeno of Citium founds his stoic school in Athens.
310 Battle of White Tunis (near modern Tunis, Tunisia)
307 Epicurus founds his philosophic school in Athens.
305–30 Ptolemaic Kingdom.
305 Seleucia, also known as *Seleucia-on-Tigris* or *Seleucia on the Tigris* (modern Iraq) is founded by Seleucus I Nicator
301 Battle of Ipsus.
300 Antioch, is founded by Seleucus I Nicator in honor of his father Antiochus
300 Euclid, Greek mathematician, publishes *Elements*, treating both geometry and number theory (see also Euclidean algorithm).
295 Athens falls to Demetrius, Lachares killed.
282–133 Kingdom of Pergamon.
281 Creation of the Achaean League.
280 The Greek colony of Aspalathos (Ἀσπάλαθος) is founded (modern day Split).
280–275 Pyrrhic War.
279 Gallic invasion of the Balkans.
274–271 First Syrian War.
267–262 Chremonidean War.
265 Archimedes, Greek mathematician, develops Archimedes' screw, specific gravity, center of gravity; anticipates discoveries of integral calculus.
260–253 Second Syrian War.
256–125 Greco-Bactrian Kingdom.
246–241 Third Syrian War.
235 Tanais (Rostov-on-Don, Russia) is founded by merchant adventurers from Miletus
220 Euthydemus I of the Greco-Bactrians led expeditions as far as Kashgar and Ürümqi in Xinjiang, leading to the first known contacts between China and the West.
219–217 Fourth Syrian War.
214–205 First Macedonian War.
203–200 Fifth Syrian War.
200–196 Second Macedonian War.
192–188 Roman–Syrian War.
180–10 AC Indo-Greek Kingdom.
• 172–167 Third Macedonian War.
• 170–168 Sixth Syrian War.
• 155 BC Attack of the Indo-Greeks on Pataliputra, a magnificent fortified city with 570 towers and 64 gates according to Megasthenes, who describes the ultimate destruction of the city's walls.
• 150 BC King Attalus II of Pergamon founds the city of Attaleia or Antalya in his honour.
• 150–148 Fourth Macedonian War.
• 146–146 Battle of Corinth

Timeline of communication technology

Timeline of writing technology

• 30,000 BC – In ice-age Europe, people mark ivory, bone, and stone with patterns to keep track of time, using a lunar calendar.
• 14,000 BC – In what is now Mezhirich, Ukraine, the first known artifact with a map on it is made using bone.
• Prior to 3500 BC – Communication was carried out through paintings of indigenous tribes.
• 3500s BC – The Sumerians develop cuneiform writing and the Egyptians develop hieroglyphic writing.
• 16th century BC – The Phoenicians develop an alphabet.
• 105 – Tsai Lun invents paper.
• 7th century – Hindu-Malayan empires write legal documents on copper plate scrolls, and write other documents on more perishable media.
• 751 – Paper is introduced to the Muslim world after the Battle of Talas.
• 1250 – The quill is used for writing.

Timeline of printing technology

• 1305 – The Chinese develop wooden block movable type printing.
• 1450 – Johannes Gutenberg invents a printing press with metal movable type.
• 1844 – Charles Fenerty produces paper from a wood pulp, eliminating rag paper which was in limited supply.
History of telecommunication

Pre-electric

- AD 26–37 – Roman Emperor Tiberius rules the empire from the island of Capri by signaling messages with metal mirrors to reflect the sun.
- 1520 – Ships on Ferdinand Magellan's voyage signal to each other by firing cannon and raising flags.

Telegraph

- 1792 – Claude Chappe establishes the first long-distance semaphore telegraph line.
- 1831 – Joseph Henry proposes and builds an electric telegraph.
- 1836 – Samuel Morse develops the Morse code.
- 1843 – Samuel Morse builds the first long distance electric telegraph line.

Landline telephone

- 1876 – Alexander Graham Bell and Thomas A. Watson exhibit an electric telephone in Boston.
- 1889 – Almon Strowger patents the direct dial

Phonograph

- 1877 – Thomas Edison patents the phonograph.

Radio and television

- 1920 – Radio station KDKA based in Pittsburgh began the first broadcast.
- 1925 – John Logie Baird transmits the first television signal.
- 1942 – Hedy Lamarr and George Antheil invent frequency hopping spread spectrum communication technique.
- 1947 – Full-scale commercial television is first broadcast.
• 1963 – First geosynchronous communications satellite is launched, 17.5 years after Arthur C. Clarke's article.
• 1999 – Sirius satellite radio is introduced.

Fax
• 1843 – Patent issued for the "Electric Printing Telegraph", a very early forerunner of the fax machine
• 1926 – Commercial availability of the radiofax
• 1964 – First modern fax machine commercially available (Long Distance Xerography)

Mobile telephone
• 1947 – Douglas H. Ring and W. Rae Young of Bell Labs propose a cell-based approach which led to "cellular phones."
• 1981 – Nordic Mobile Telephone, the world's first automatic mobile phone is put into operation
• 1991 – GSM is put into operation
• 1992 – Neil Papworth sends the first SMS (or text message).
• 1999 – 45% of Australians have a mobile phone.

Computers and Internet
• 1949 – Claude Elwood Shannon, the "father of information theory", mathematically proves the Nyquist–Shannon sampling theorem.
• 1965 – First email sent (at MIT).
• 1966 – Charles Kao realizes that silica-based optical waveguides offer a practical way to transmit light via total internal reflection.
• 1969 – The first hosts of ARPANET, Internet's ancestor, are connected.
• 1971 – Erna Schneider Hoover invent a computerized switching system for telephone traffic.
• 1971 – 8-inch floppy disk removable storage medium for computers is introduced.
• 1975 – "First list servers are introduced."
• 1976 – The personal computer (PC) market is born.
• 1977 – Donald Knuth begins work on TeX.
• 1981 – Hayes Smartmodem introduced.
• 1983 – Microsoft Word software is launched.
• 1985 – AOL is launched.
• 1989 – Tim Berners-Lee and Robert Cailliau build the prototype system which became the World Wide Web at CERN.
• 1989 – WordPerfect 5.1 word processing software released.
• 1989 – Lotus Notes software is launched.
• 1991 – Anders Olsson transmits solitary waves through an optical fiber with a data rate of 32 billion bits per second.
• 1992 – Internet2 organization is created.
• 1992 – IBM ThinkPad 700C laptop computer created. It was lightweight compared to its predecessors.
• 1993 – Mosaic graphical web browser is launched.
• 1994 – Internet radio broadcasting is born.
• 1996 – Motorola StarTAC mobile phone introduced. It was significantly smaller than previous cellphones.
• 1997 – SixDegrees.com is launched, the first of a number of early social networking services
• 1999 – Napster peer-to-peer file sharing is launched.
• 2001 – Cyworld adds social networking features and becomes the first of a number of mass-market social networking service
• 2003 – Skype video calling software is launched.
• 2004 – Facebook is launched, becoming the largest social networking site in 2009.
• 2005 – YouTube, the video sharing site, is launched.
• 2006 – Twitter is launched.
• 2007 – iPhone is launched.
• 2009 – Whatsapp is launched.
• 2010 – Instagram is launched.
• 2011 – Snapchat is launched.
• 2015 – Discord is launched.

Timeline of coaching psychology

1900s

In 1951, John Lawther of Penn State University published *Psychology of Coaching.*

In 1967 Curtiss Gaylord published a book titled *Modern Coaching Psychology,* the first book to use "coaching psychology" in its title.


In 1976, Tim Gallwey publishes the book, *The Inner Game of Tennis.*

In 1977, James O. Prochaska of the University of Rhode Island, and Carlo Di Clemente and colleagues developed the transtheoretical model.

In 1981, earliest known mention of S.M.A.R.T. goals

In the late 1980s and 1990s, the GROW model was developed in the United Kingdom and was used extensively in corporate coaching.

In 1997, Max Landsberg writes up GROW model in *The tao of coaching.*

**21st century**

In January 2000, Anthony Grant established the Coaching Psychology Unit at University of Sydney and through his doctoral studies set the stage for further research into coaching as an evidence-based discipline.

In 2003, International Journal of Mentoring and Coaching in Education was formed.

In 2005, the journal *The Coaching Psychologist* was founded by the British Psychological Society.

In 2006, Australian Psychological Society (APS) founded the Interest Group in Coaching Psychology (IGCP).

In 2006, British Psychological Society (BPS) formed the Special Group in Coaching Psychology (SGCP).

On December 18, 2006, the International Society for Coaching Psychology (ISCP) was founded in order to promote the international development of the field.


In 2008, The Journal Coaching: An International Journal of Theory, Research and Practice was formed.


In 2009, Swedish Coaching Psychology Group was formed.

2011, Society for Coaching changed name to "International Centre for Coaching Psychology Research.

In 2012, The Danish Journal of Coaching Psychology was founded.
Timeline of women in mathematics in the United States

- 1829: The first public examination of an American girl in geometry was held.
- 1886: Winifred Edgerton Merrill became the first American woman to earn a PhD in mathematics, which she earned from Columbia University.
- 1913: Mildred Sanderson earned her PhD for a thesis that included an important theorem about modular invariants.
- 1927: Anna Pell-Wheeler became the first woman to present a lecture at the American Mathematical Society Colloquium.
- 1943: Euphemia Haynes became the first African-American woman to earn a Ph.D. in mathematics, which she earned from Catholic University of America.
- 1949: Gertrude Mary Cox became the first woman elected into the International Statistical Institute.
- 1956: Gladys West began collecting data from satellites at the Naval Surface Warfare Center Dahlgren Division. Her calculations directly impacted the development of accurate GPS systems.
- 1962: Mina Rees became the first woman to win the Mathematical Association of America's highest honor, the Yueh-Gin Gung and Dr. Charles Y. Hu Award for Distinguished Service to Mathematics.
- 1966: Mary L. Boas published *Mathematical Methods in the Physical Sciences*, which was still widely used in college classrooms as of 1999.
- 1970: Mina Rees became the first female president of the American Association for the Advancement of Science.
- 1971:
  - Mary Ellen Rudin constructed the first Dowker space.
  - The Association for Women in Mathematics (AWM) was founded. It is a professional society whose mission is to encourage women and girls to study and to have active careers in the mathematical sciences, and to promote equal opportunity for and the equal treatment of women and girls in the mathematical sciences. It is incorporated in the state of Massachusetts.
  - The American Mathematical Society established its Joint Committee on Women in the Mathematical Sciences (JCW), which later became a joint committee of multiple scholarly societies.
- 1973: Jean Taylor published her dissertation on “Regularity of the Singular Set of Two-Dimensional Area-Minimizing Flat Chains Modulo 3 in R3” which solved a long-standing problem about length and smoothness of soap-film triple function curves.
1974: Joan Birman published the book *Braids, Links, and Mapping Class Groups*. It has become a standard introduction, with many of today’s researchers having learned the subject through it.

1975–1977: Marjorie Rice, who had no formal training in mathematics beyond high school, discovered three new types of tessellating pentagons and more than sixty distinct tessellations by pentagons.

1975: Julia Robinson became the first female mathematician elected to the National Academy of Sciences.

1979:
  - Dorothy Lewis Bernstein became the first female president of the Mathematical Association of America.
  - Mary Ellen Rudin became the first woman to present the MAA's Earle Raymond Hedrick Lectures, intended to showcase skilled expositors and enrich the understanding of instructors of college-level mathematics.

1981: Doris Schattschneider became the first female editor of *Mathematics Magazine*, a refereed bimonthly publication of the Mathematical Association of America.

1983: Julia Robinson became the first female president of the American Mathematical Society, and the first female mathematician to be awarded a MacArthur Fellowship.

1988: Doris Schattschneider became the first woman to present the MAA's J. Sutherland Frame Lectures.

1992: Gloria Gilmer became the first woman to deliver a major National Association of Mathematicians lecture (it was the Cox-Talbot address).

1995: Margaret Wright became the first female president of the Society for Industrial and Applied Mathematics.

1996: Joan Birman became the first woman to receive the MAA's Chauvenet Prize, an annual award for expository articles.


2002: Melanie Wood became the first American woman and second woman overall to be named a Putnam Fellow in 2002. Putnam Fellows are the top five (or six, in case of a tie) scorers on William Lowell Putnam Mathematical Competition.

2004:
  - Melanie Wood became the first woman to win the Frank and Brennie Morgan Prize for Outstanding Research in Mathematics by an Undergraduate Student. It is an annual award given to an undergraduate student in the US, Canada, or Mexico who demonstrates superior mathematics research.
  - Alison Miller became the first female gold medal winner on the U.S. International Mathematical Olympiad Team.
• 2006: Stefanie Petermichl, a German mathematical analyst then at the University of Texas at Austin, became the first woman to win the Salem Prize, an annual award given to young mathematicians who have worked in Raphael Salem's field of interest, chiefly topics in analysis related to Fourier series. She shared the prize with Artur Avila.

• 2007: Kaumudi Joshipura, an Indian dentist-scientist, biostatistician, and epidemiologist became the NIH endowed chair and director of the center for clinical research and health promotion at University of Puerto Rico, Medical Sciences Campus.

• 2019: Karen Uhlenbeck became the first woman to win the Abel Prize, with the award committee citing the fundamental impact of her work on analysis, geometry and mathematical physics.

Timeline of mathematics

Rhetorical stage

Before 1000 BC

• ca. 70,000 BC – South Africa, ochre rocks adorned with scratched geometric patterns (see Blombos Cave).

• ca. 35,000 BC to 20,000 BC – Africa and France, earliest known prehistoric attempts to quantify time.

• c. 20,000 BC – Nile Valley, Ishango Bone: possibly the earliest reference to prime numbers and Egyptian multiplication.

• c. 3400 BC – Mesopotamia, the Sumerians invent the first numeral system, and a system of weights and measures.

• c. 3100 BC – Egypt, earliest known decimal system allows indefinite counting by way of introducing new symbols.

• c. 2800 BC – Indus Valley Civilization on the Indian subcontinent, earliest use of decimal ratios in a uniform system of ancient weights and measures, the smallest unit of measurement used is 1.704 millimetres and the smallest unit of mass used is 28 grams.

• 2700 BC – Egypt, precision surveying.

• 2400 BC – Egypt, precise astronomical calendar, used even in the Middle Ages for its mathematical regularity.

• c. 2000 BC – Mesopotamia, the Babylonians use a base-60 positional numeral system, and compute the first known approximate value of π at 3.125.
• c. 2000 BC – Scotland, Carved Stone Balls exhibit a variety of symmetries including all of the symmetries of Platonic solids.

• 1800 BC – Egypt, Moscow Mathematical Papyrus, findings volume of a frustum.

• c. 1800 BC – Berlin Papyrus 6619 (Egypt, 19th dynasty) contains a quadratic equation and its solution.

• 1650 BC – Rhind Mathematical Papyrus, copy of a lost scroll from around 1850 BC, the scribe Ahmes presents one of the first known approximate values of π at 3.16, the first attempt at squaring the circle, earliest known use of a sort of cotangent, and knowledge of solving first order linear equations.

Syncopated stage

1st millennium BC

• c. 1000 BC – Simple fractions used by the Egyptians. However, only unit fractions are used (i.e., those with 1 as the numerator) and interpolation tables are used to approximate the values of the other fractions.

• first half of 1st millennium BC – Vedic India – Yajnavalkya, in his Shatapatha Brahmana, describes the motions of the sun and the moon, and advances a 95-year cycle to synchronize the motions of the sun and the moon.

• 800 BC – Baudhayana, author of the Baudhayana Sulba Sutra, a Vedic Sanskrit geometric text, contains quadratic equations, and calculates the square root of two correctly to five decimal places.

• c. 8th century BC – the Yajur Veda, one of the four Hindu Vedas, contains the earliest concept of infinity, and states "if you remove a part from infinity or add a part to infinity, still what remains is infinity."

• 1046 BC to 256 BC – China, Zhoubi Suanjing, arithmetic, geometric algorithms, and proofs.

• 624 BC – 546 BC – Greece, Thales of Miletus has various theorems attributed to him.

• c. 600 BC – Greece, the other Vedic "Sulba Sutras" ("rule of chords" in Sanskrit) use Pythagorean triples, contain a number of geometrical proofs, and approximate π at 3.16.

• second half of 1st millennium BC – The Lo Shu Square, the unique normal magic square of order three, was discovered in China.

• 530 BC – Greece, Pythagoras studies propositional geometry and vibrating lyre strings; his group also discovers the irrationality of the square root of two.

• c. 510 BC – Greece, Anaxagoras

• c. 500 BC – Indian grammarian Pāṇini writes the Astadhyayi, which contains the use of metarules, transformations and recursions, originally for the purpose of systematizing the grammar of Sanskrit.

• c. 500 BC – Greece, Oenopides of Chios
• 470 BC – 410 BC – Greece, Hippocrates of Chios utilizes lunes in an attempt to square the circle.
• 490 BC – 430 BC – Greece, Zeno of Elea *Zeno's paradoxes*
• 5th century BC – India, Apastamba, author of the Apastamba Sulba Sutra, another Vedic Sanskrit geometric text, makes an attempt at squaring the circle and also calculates the square root of 2 correct to five decimal places.
• 5th c. BC – Greece, Theodorus of Cyrene
• 5th century – Greece, Antiphon the Sophist
• 460 BC – 370 BC – Greece, Democritus
• 460 BC – 399 BC – Greece, Hippias
• 5th century (late) – Greece, Bryson of Heraclea
• 428 BC – 347 BC – Greece, Archytas
• 423 BC – 347 BC – Greece, Plato
• 417 BC – 317 BC – Greece, Theaetetus (mathematician)
• c. 400 BC – India, Jaina mathematicians write the *Surya Prajinapti*, a mathematical text classifying all numbers into three sets: enumerable, innumerable and infinite. It also recognise five different types of infinity: infinite in one and two directions, infinite in area, infinite everywhere, and infinite perpetually.
• 408 BC – 355 BC – Greece, Eudoxus of Cnidus
• 400 BC – 350 BC – Greece, Thymaridas
• 395 BC – 313 BC – Greece, Xenocrates
• 390 BC – 320 BC – Greece, Dinonstratus
• 380–290 – Greece, Autolycus of Pitane
• 370 BC – Greece, Eudoxus states the method of exhaustion for area determination.
• 370 BC – 300 BC – Greece, Aristaeus the Elder
• 370 BC – 300 BC – Greece, Callippus
• 350 BC – Greece, Aristotle discusses logical reasoning in *Organon*.
• 4th century BC – Indian texts use the Sanskrit word "Shunya" to refer to the concept of "void" (zero).
• 330 BC – China, the earliest known work on Chinese geometry, the *Mo Jing*, is compiled.
• 310 BC – 230 BC – Greece, Aristarchus of Samos
• 390 BC – 310 BC – Greece, Heraclides of Pontus
• 380 BC – 320 BC – Greece, Menaechmus
• 300 BC – India, Jain mathematicians in India write the *Bhagabati Sutra*, which contains the earliest information on combinations.
300 BC – Greece, Euclid in his *Elements* studies geometry as an axiomatic system, proves the infinitude of prime numbers and presents the Euclidean algorithm; he states the law of reflection in *Catoptrics*, and he proves the fundamental theorem of arithmetic.

c. 300 BC – India, Brahmi numerals (ancestor of the common modern base 10 numeral system)

370 BC – 300 BC – Greece, Eudemus of Rhodes works on histories of arithmetic, geometry and astronomy now lost.

300 BC – Mesopotamia, the Babylonians invent the earliest calculator, the abacus.

c. 300 BC – Indian mathematician Pingala writes the *Chhandah-shastra*, which contains the first Indian use of zero as a digit (indicated by a dot) and also presents a description of a binary numeral system, along with the first use of Fibonacci numbers and Pascal's triangle.

280 BC – 210 BC – Greece, Nicomedes (mathematician)

280 BC – 220 BC – Greece, Philon of Byzantium

280 BC – 220 BC – Greece, Conon of Samos

279 BC – 206 BC – Greece, Chrysippus

c. 3rd century BC – India, Kātyāyana

250 BC – 190 BC – Greece, Dionysodorus

262 -198 BC – Greece, Apollonius of Perga

260 BC – Greece, Archimedes proved that the value of π lies between 3 + 1/7 (approx. 3.1429) and 3 + 10/71 (approx. 3.1408), that the area of a circle was equal to π multiplied by the square of the radius of the circle and that the area enclosed by a parabola and a straight line is 4/3 multiplied by the area of a triangle with equal base and height. He also gave a very accurate estimate of the value of the square root of 3.

c. 250 BC – late Olmecs had already begun to use a true zero (a shell glyph) several centuries before Ptolemy in the New World. See 0 (number).

240 BC – Greece, Eratosthenes uses his sieve algorithm to quickly isolate prime numbers.

240 BC 190 BC – Greece, Diocles (mathematician)

225 BC – Greece, Apollonius of Perga writes *On Conic Sections* and names the ellipse, parabola, and hyperbola.

202 BC to 186 BC – China, *Book on Numbers and Computation*, a mathematical treatise, is written in Han Dynasty.

200 BC – 140 BC – Greece, Zenodorus (mathematician)

150 BC – India, Jain mathematicians in India write the *Sthananga Sutra*, which contains work on the theory of numbers, arithmetical operations, geometry, operations with fractions, simple equations, cubic equations, quartic equations, and permutations and combinations.
• c. 150 BC – Greece, Perseus (geometer)
• 150 BC – China, A method of Gaussian elimination appears in the Chinese text *The Nine Chapters on the Mathematical Art*.
• 150 BC – China, Horner’s method appears in the Chinese text *The Nine Chapters on the Mathematical Art*.
• 150 BC – China, Negative numbers appear in the Chinese text *The Nine Chapters on the Mathematical Art*.
• 150 BC – 75 BC – Phoenician, Zeno of Sidon
• 190 BC – 120 BC – Greece, Hipparchus develops the bases of trigonometry.
• 190 BC – 120 BC – Greece, Hypsicles
• 160 BC – 100 BC – Greece, Theodosius of Bithynia
• 135 BC – 51 BC – Greece, Posidonius
• 206 BC to 8 AD – China, Counting rods
• 78 BC – 37 BC – China, Jing Fang
• 50 BC – Indian numerals, a descendant of the Brahmi numerals (the first positional notation base-10 numeral system), begins development in India.
• mid 1st century Cleomedes (as late as 400 AD)
• final centuries BC – Indian astronomer Lagadha writes the *Vedanga Jyotisha*, a Vedic text on astronomy that describes rules for tracking the motions of the sun and the moon, and uses geometry and trigonometry for astronomy.
• 1st C. BC – Greece, Geminus
• 50 BC – 23 AD – China, Liu Xin

1st millennium AD

• 1st century – Greece, Heron of Alexandria, (Hero) the earliest fleeting reference to square roots of negative numbers.
• c 100 – Greece, Theon of Smyrna
• 60 – 120 – Greece, Nicomachus
• 70 – 140 – Greece, Menelaus of Alexandria Spherical trigonometry
• 78 – 139 – China, Zhang Heng
• c. 2nd century – Greece, Ptolemy of Alexandria wrote the *Almagest*.
• 132 – 192 – China, Cai Yong
• 240 – 300 – Greece, Sporus of Nicaea
• 250 – Greece, Diophantus uses symbols for unknown numbers in terms of syncopated algebra, and writes *Arithmetica*, one of the earliest treatises on algebra.

• 263 – China, Liu Hui computes π using Liu Hui's π algorithm.

• 300 – the earliest known use of zero as a decimal digit is introduced by Indian mathematicians.

• 234 – 305 – Greece, Porphyry (philosopher)

• 300 – 360 – Greece, Serenus of Antinouplis

• 335 – 405 – Greece, Theon of Alexandria

• c. 340 – Greece, Pappus of Alexandria states his hexagon theorem and his centroid theorem.

• 350 – 415 – Byzantine Empire, Hypatia

• c. 400 – India, the Bakhshali manuscript is written by Jaina mathematicians, which describes a theory of the infinite containing different levels of infinity, shows an understanding of indices, as well as logarithms to base 2, and computes square roots of numbers as large as a million correct to at least 11 decimal places.

• 300 to 500 – the Chinese remainder theorem is developed by Sun Tzu.

• 300 to 500 – China, a description of rod calculus is written by Sun Tzu.

• 412 – 485 – Greece, Proclus

• 420 – 480 – Greece, Domninus of Larissa

• b 440 – Greece, Marinus of Neapolis "I wish everything was mathematics."

• 450 – China, Zu Chongzhi computes π to seven decimal places. This calculation remains the most accurate calculation for π for close to a thousand years.

• c. 474 – 558 – Greece, Anthemius of Tralles

• 500 – India, Aryabhata writes the *Aryabhata-Siddhanta*, which first introduces the trigonometric functions and methods of calculating their approximate numerical values. It defines the concepts of sine and cosine, and also contains the earliest tables of sine and cosine values (in 3.75-degree intervals from 0 to 90 degrees).

• 480 – 540 – Greece, Eutocius of Ascalon

• 490 – 560 – Greece, Simplicius of Cilicia

• 6th century – Aryabhata gives accurate calculations for astronomical constants, such as the solar eclipse and lunar eclipse, computes π to four decimal places, and obtains whole number solutions to linear equations by a method equivalent to the modern method.

• 505 – 587 – India, Varāhamihira

• 6th century – India, Yatīrśabha

• 535 – 566 – China, Zhen Luan
550 – Hindu mathematicians give zero a numeral representation in the positional notation Indian numeral system.

7th century – India, Bhaskara I gives a rational approximation of the sine function.

7th century – India, Brahmagupta invents the method of solving indeterminate equations of the second degree and is the first to use algebra to solve astronomical problems. He also develops methods for calculations of the motions and places of various planets, their rising and setting, conjunctions, and the calculation of eclipses of the sun and the moon.

628 – Brahmagupta writes the *Brahma-sphuta-siddhanta*, where zero is clearly explained, and where the modern place-value Indian numeral system is fully developed. It also gives rules for manipulating both negative and positive numbers, methods for computing square roots, methods of solving linear and quadratic equations, and rules for summing series, Brahmagupta's identity, and the Brahmagupta theorem.

602 – 670 – China, Li Chunfeng

8th century – India, Virasena gives explicit rules for the Fibonacci sequence, gives the derivation of the volume of a frustum using an infinite procedure, and also deals with the logarithm to base 2 and knows its laws.

8th century – India, Shridhara gives the rule for finding the volume of a sphere and also the formula for solving quadratic equations.

773 – Iraq, Kanka brings Brahmagupta's *Brahma-sphuta-siddhanta* to Baghdad to explain the Indian system of arithmetic astronomy and the Indian numeral system.

773 – Al-Fazari translates the *Brahma-sphuta-siddhanta* into Arabic upon the request of King Khalif Abbasid Al Mansoor.

9th century – India, Govindsvamin discovers the Newton-Gauss interpolation formula, and gives the fractional parts of Aryabhata's tabular sines.

810 – The House of Wisdom is built in Baghdad for the translation of Greek and Sanskrit mathematical works into Arabic.

820 – Al-Khwarizmi – Persian mathematician, father of algebra, writes the *Al-Jabr*, later transliterated as *Algebra*, which introduces systematic algebraic techniques for solving linear and quadratic equations. Translations of his book on arithmetic will introduce the Hindu-Arabic decimal number system to the Western world in the 12th century. The term *algorithm* is also named after him.

820 – Iran, Al-Mahani conceived the idea of reducing geometrical problems such as doubling the cube to problems in algebra.

• c. 850 – India, Mahāvīra writes the Gañitaśrāsaṅgraha otherwise known as the Ganita Sara Samgraha which gives systematic rules for expressing a fraction as the sum of unit fractions.

• 895 – Syria, Thabit ibn Qurra: the only surviving fragment of his original work contains a chapter on the solution and properties of cubic equations. He also generalized the Pythagorean theorem, and discovered the theorem by which pairs of amicable numbers can be found, (i.e., two numbers such that each is the sum of the proper divisors of the other).

• c. 900 – Egypt, Abu Kamil had begun to understand what we would write in symbols as $x^n x^m = x^{m+n}$

• 940 – Iran, Abu'l-Wafa al-Buzjani extracts roots using the Indian numeral system.

• 953 – The arithmetic of the Hindu-Arabic numeral system at first required the use of a dust board (a sort of handheld blackboard) because "the methods required moving the numbers around in the calculation and rubbing some out as the calculation proceeded." Al-Uqlidisi modified these methods for pen and paper use. Eventually the advances enabled by the decimal system led to its standard use throughout the region and the world.

• 953 – Persia, Al-Karaji is the "first person to completely free algebra from geometrical operations and to replace them with the arithmetical type of operations which are at the core of algebra today. He was first to define the monomials $x, x^2, x^3, \ldots$ and $1/x, 1/x^2, 1/x^3, \ldots$ and to give rules for products of any two of these. He started a school of algebra which flourished for several hundreds of years". He also discovered the binomial theorem for integer exponents, which "was a major factor in the development of numerical analysis based on the decimal system".

• 975 – Mesopotamia, Al-Batani extended the Indian concepts of sine and cosine to other trigonometrical ratios, like tangent, secant and their inverse functions. Derived the formulae: $\sin \alpha = \tan \alpha / \sqrt{1 + \tan^2 \alpha}$ and $\cos \alpha = 1 / \sqrt{1 + \tan^2 \alpha}$.

Symbolic stage

1000–1500

• c. 1000 – Abū Sahl al-Qūhī (Kuhi) solves equations higher than the second degree.

• c. 1000 – Abu-Mahmud al-Khujandi first states a special case of Fermat's Last Theorem.

• c. 1000 – Law of sines is discovered by Muslim mathematicians, but it is uncertain who discovers it first between Abu-Mahmud al-Khujandi, Abu Nasr Mansur, and Abu al-Wafa.

• c. 1000 – Pope Sylvester II introduces the abacus using the Hindu-Arabic numeral system to Europe.
1000 – Al-Karaji writes a book containing the first known proofs by mathematical induction. He used it to prove the binomial theorem, Pascal's triangle, and the sum of integral cubes. He was "the first who introduced the theory of algebraic calculus".

c. 1000 – Ibn Tahir al-Baghdadi studied a slight variant of Thabit ibn Qurra's theorem on amicable numbers, and he also made improvements on the decimal system.

1020 – Abul Wáfa gave the formula: $\sin (\alpha + \beta) = \sin \alpha \cos \beta + \sin \beta \cos \alpha$. Also discussed the quadrature of the parabola and the volume of the paraboloid.

1021 – Ibn al-Haytham formulated and solved Alhazen's problem geometrically.

1030 – Ali Ahmad Nasawi writes a treatise on the decimal and sexagesimal number systems. His arithmetic explains the division of fractions and the extraction of square and cubic roots (square root of 57,342; cubic root of 3, 652, 296) in an almost modern manner.

1070 – Omar Khayyám begins to write *Treatise on Demonstration of Problems of Algebra* and classifies cubic equations.

c. 1100 – Omar Khayyám "gave a complete classification of cubic equations with geometric solutions found by means of intersecting conic sections". He became the first to find general geometric solutions of cubic equations and laid the foundations for the development of analytic geometry and non-Euclidean geometry. He also extracted roots using the decimal system (Hindu-Arabic numeral system).

12th century – Indian numerals have been modified by Arab mathematicians to form the modern Arabic numeral system (used universally in the modern world).

12th century – the Arabic numeral system reaches Europe through the Arabs.

12th century – Bhaskara Acharya writes the Lilavati, which covers the topics of definitions, arithmetical terms, interest computation, arithmetical and geometrical progressions, plane geometry, solid geometry, the shadow of the gnomon, methods to solve indeterminate equations, and combinations.

12th century – Bhāskara II (Bhaskara Acharya) writes the *Bījaganīṭa (Algebra)*, which is the first text to recognize that a positive number has two square roots.

12th century – Bhaskara Acharya conceives differential calculus, and also develops Rolle's theorem, Pell's equation, a proof for the Pythagorean Theorem, proves that division by zero is infinity, computes $\pi$ to 5 decimal places, and calculates the time taken for the earth to orbit the sun to 9 decimal places.

1130 – Al-Samawal gave a definition of algebra: "[it is concerned] with operating on unknowns using all the arithmetical tools, in the same way as the arithmetician operates on the known."

1135 – Sharafeddin Tusi followed al-Khayyam's application of algebra to geometry, and wrote a treatise on cubic equations that "represents an essential contribution to another algebra which aimed to study curves by means of equations, thus inaugurating the beginning of algebraic geometry".
• 1202 – Leonardo Fibonacci demonstrates the utility of Hindu-Arabic numerals in his Liber Abaci (*Book of the Abacus*).

• 1247 – Qin Jiushao publishes *Shùshū Jiǔzhāng* (*Mathematical Treatise in Nine Sections*).

• 1248 – Li Ye writes *Ceyuan haijing*, a 12 volume mathematical treatise containing 170 formulas and 696 problems mostly solved by polynomial equations using the method tian yuan shu.

• 1260 – Al-Farisi gave a new proof of Thabit ibn Qurra’s theorem, introducing important new ideas concerning factorization and combinatorial methods. He also gave the pair of amicable numbers 17296 and 18416 that have also been joint attributed to Fermat as well as Thabit ibn Qurra.

• c. 1250 – Nasir Al-Din Al-Tusi attempts to develop a form of non-Euclidean geometry.

• 1303 – Zhu Shijie publishes *Precious Mirror of the Four Elements*, which contains an ancient method of arranging binomial coefficients in a triangle.

• 14th century – Madhava is considered the father of mathematical analysis, who also worked on the power series for π and for sine and cosine functions, and along with other Kerala school mathematicians, founded the important concepts of calculus.

• 14th century – Parameshvara, a Kerala school mathematician, presents a series form of the sine function that is equivalent to its Taylor series expansion, states the mean value theorem of differential calculus, and is also the first mathematician to give the radius of circle with inscribed cyclic quadrilateral.

15th century

• 1400 – Madhava discovers the series expansion for the inverse-tangent function, the infinite series for arctan and sin, and many methods for calculating the circumference of the circle, and uses them to compute π correct to 11 decimal places.

• c. 1400 – Ghiyath al-Kashi "contributed to the development of decimal fractions not only for approximating algebraic numbers, but also for real numbers such as π. His contribution to decimal fractions is so major that for many years he was considered as their inventor. Although not the first to do so, al-Kashi gave an algorithm for calculating nth roots, which is a special case of the methods given many centuries later by [Paolo] Ruffini and [William George] Horner." He is also the first to use the decimal point notation in arithmetic and Arabic numerals. His works include *The Key of arithmetics, Discoveries in mathematics, The Decimal point, and The benefits of the zero*. The contents of the *Benefits of the Zero* are an introduction followed by five essays: "On whole number arithmetic", "On fractional arithmetic", "On astrology", "On areas", and "On finding the unknowns [unknown variables]". He also wrote the *Thesis on the sine and the chord* and *Thesis on finding the first degree sine*.

• 15th century – Ibn al-Banna and al-Qalasadi introduced symbolic notation for algebra and for mathematics in general.
• 15th century – Nilakantha Somayaji, a Kerala school mathematician, writes the *Aryabhatiya Bhasya*, which contains work on infinite-series expansions, problems of algebra, and spherical geometry.

• 1424 – Ghiyath al-Kashi computes \( \pi \) to sixteen decimal places using inscribed and circumscribed polygons.

• 1427 – Al-Kashi completes *The Key to Arithmetic* containing work of great depth on decimal fractions. It applies arithmetical and algebraic methods to the solution of various problems, including several geometric ones.

• 1464 – Regiomontanus writes *De Triangulis omnimodus* which is one of the earliest texts to treat trigonometry as a separate branch of mathematics.

• 1478 – An anonymous author writes the *Treviso Arithmetic*.

• 1494 – Luca Pacioli writes *Summa de arithmetica, geometria, proportioni et proportionalità*; introduces primitive symbolic algebra using "co" (cosa) for the unknown.

**Modern**

**16th century**

• 1501 – Nilakantha Somayaji writes the *Tantrasamgraha*.

• 1520 – Scipione dal Ferro develops a method for solving "depressed" cubic equations (cubic equations without an \( x^2 \) term), but does not publish.

• 1522 – Adam Ries explained the use of Arabic digits and their advantages over Roman numerals.

• 1535 – Niccolò Tartaglia independently develops a method for solving depressed cubic equations but also does not publish.

• 1539 – Gerolamo Cardano learns Tartaglia's method for solving depressed cubics and discovers a method for depressing cubics, thereby creating a method for solving all cubics.

• 1540 – Lodovico Ferrari solves the quartic equation.

• 1544 – Michael Stifel publishes *Arithmetica integra*.

• 1545 – Gerolamo Cardano conceives the idea of complex numbers.

• 1550 – Jyeshtadeva, a Kerala school mathematician, writes the *Yuktibhāṣā*, the world's first calculus text, which gives detailed derivations of many calculus theorems and formulae.

• 1572 – Rafael Bombelli writes *Algebra* treatise and uses imaginary numbers to solve cubic equations.

• 1584 – Zhu Zaiyu calculates equal temperament.

• 1596 – Ludolf van Ceulen computes \( \pi \) to twenty decimal places using inscribed and circumscribed polygons.
17th century

- 1614 – John Napier discusses Napierian logarithms in *Mirifici Logarithmorum Canonis Descriptio*.
- 1617 – Henry Briggs discusses decimal logarithms in *Logarithmorum Chilias Prima*.
- 1618 – John Napier publishes the first references to e in a work on logarithms.
- 1619 – René Descartes discovers analytic geometry (Pierre de Fermat claimed that he also discovered it independently).
- 1619 – Johannes Kepler discovers two of the Kepler-Poinsot polyhedra.
- 1629 – Pierre de Fermat develops a rudimentary differential calculus.
- 1634 – Gilles de Roberval shows that the area under a cycloid is three times the area of its generating circle.
- 1636 – Muhammad Baqir Yazdi jointly discovered the pair of amicable numbers 9,363,584 and 9,437,056 along with Descartes (1636).
- 1637 – Pierre de Fermat claims to have proven Fermat's Last Theorem in his copy of Diophantus' *Arithmetica*.
- 1637 – First use of the term imaginary number by René Descartes; it was meant to be derogatory.
- 1643 – René Descartes develops Descartes' theorem.
- 1654 – Blaise Pascal and Pierre de Fermat create the theory of probability.
- 1655 – John Wallis writes *Arithmetica Infinitorum*.
- 1658 – Christopher Wren shows that the length of a cycloid is four times the diameter of its generating circle.
- 1665 – Isaac Newton works on the fundamental theorem of calculus and develops his version of infinitesimal calculus.
- 1668 – Nicholas Mercator and William Brouncker discover an infinite series for the logarithm while attempting to calculate the area under a hyperbolic segment.
- 1671 – James Gregory develops a series expansion for the inverse-tangent function (originally discovered by Madhava).
- 1671 – James Gregory discovers Taylor's Theorem.
- 1673 – Gottfried Leibniz also develops his version of infinitesimal calculus.
- 1675 – Isaac Newton invents an algorithm for the computation of functional roots.
- 1680s – Gottfried Leibniz works on symbolic logic.
- 1683 – Seki Takakazu discovers the resultant and determinant.
- 1683 – Seki Takakazu develops elimination theory.
• 1691 – Gottfried Leibniz discovers the technique of separation of variables for ordinary differential equations.

• 1693 – Edmund Halley prepares the first mortality tables statistically relating death rate to age.

• 1696 – Guillaume de L'Hôpital states his rule for the computation of certain limits.

• 1696 – Jakob Bernoulli and Johann Bernoulli solve brachistochrone problem, the first result in the calculus of variations.

• 1699 – Abraham Sharp calculates π to 72 digits but only 71 are correct.

18th century

• 1706 – John Machin develops a quickly converging inverse-tangent series for π and computes π to 100 decimal places.

• 1708 – Seki Takakazu discovers Bernoulli numbers. Jacob Bernoulli whom the numbers are named after is believed to have independently discovered the numbers shortly after Takakazu.

• 1712 – Brook Taylor develops Taylor series.

• 1722 – Abraham de Moivre states de Moivre's formula connecting trigonometric functions and complex numbers.

• 1722 – Takebe Kenko introduces Richardson extrapolation.

• 1724 – Abraham De Moivre studies mortality statistics and the foundation of the theory of annuities in Annuities on Lives.

• 1730 – James Stirling publishes The Differential Method.

• 1733 – Giovanni Gerolamo Saccheri studies what geometry would be like if Euclid's fifth postulate were false.

• 1733 – Abraham de Moivre introduces the normal distribution to approximate the binomial distribution in probability.

• 1734 – Leonhard Euler introduces the integrating factor technique for solving first-order ordinary differential equations.

• 1735 – Leonhard Euler solves the Basel problem, relating an infinite series to π.

• 1736 – Leonhard Euler solves the problem of the Seven bridges of Königsberg, in effect creating graph theory.

• 1739 – Leonhard Euler solves the general homogeneous linear ordinary differential equation with constant coefficients.

• 1742 – Christian Goldbach conjectures that every even number greater than two can be expressed as the sum of two primes, now known as Goldbach's conjecture.
• 1747 – Jean le Rond d'Alembert solves the vibrating string problem (one-dimensional wave equation).
• 1748 – Maria Gaetana Agnesi discusses analysis in *Instituzioni Analitiche ad Uso della Gioventu Italiana*.
• 1761 – Thomas Bayes proves Bayes' theorem.
• 1761 – Johann Heinrich Lambert proves that π is irrational.
• 1762 – Joseph Louis Lagrange discovers the divergence theorem.
• 1789 – Jurij Vega improves Machin's formula and computes π to 140 decimal places, 136 of which were correct.
• 1794 – Jurij Vega publishes *Thesaurus Logarithmorum Completus*.
• 1796 – Carl Friedrich Gauss proves that the regular 17-gon can be constructed using only a compass and straightedge.
• 1796 – Adrien-Marie Legendre conjectures the prime number theorem.
• 1797 – Caspar Wessel associates vectors with complex numbers and studies complex number operations in geometrical terms.
• 1799 – Carl Friedrich Gauss proves the fundamental theorem of algebra (every polynomial equation has a solution among the complex numbers).
• 1799 – Paolo Ruffini partially proves the Abel–Ruffini theorem that quintic or higher equations cannot be solved by a general formula.

19th century

• 1801 – *Disquisitiones Arithmeticae*, Carl Friedrich Gauss's number theory treatise, is published in Latin.
• 1805 – Adrien-Marie Legendre introduces the method of least squares for fitting a curve to a given set of observations.
• 1806 – Louis Poinsot discovers the two remaining Kepler-Poinsot polyhedra.
• 1806 – Jean-Robert Argand publishes proof of the Fundamental theorem of algebra and the Argand diagram.
• 1807 – Joseph Fourier announces his discoveries about the trigonometric decomposition of functions.
• 1811 – Carl Friedrich Gauss discusses the meaning of integrals with complex limits and briefly examines the dependence of such integrals on the chosen path of integration.
• 1815 – Siméon Denis Poisson carries out integrations along paths in the complex plane.
• 1817 – Bernard Bolzano presents the intermediate value theorem—a continuous function that is negative at one point and positive at another point must be zero for at least one point in between. Bolzano gives a first formal (ε, δ)-definition of limit.
• 1821 – Augustin-Louis Cauchy publishes Cours d'Analyse which purportedly contains an erroneous “proof” that the pointwise limit of continuous functions is continuous.

• 1822 – Augustin-Louis Cauchy presents the Cauchy integral theorem for integration around the boundary of a rectangle in the complex plane.

• 1822 – Irisawa Shintarō Hiroatsu analyzes Soddy's hexlet in a Sangaku.

• 1823 – Sophie Germain's Theorem is published in the second edition of Adrien-Marie Legendre's Essai sur la théorie des nombres.

• 1824 – Niels Henrik Abel partially proves the Abel–Ruffini theorem that the general quintic or higher equations cannot be solved by a general formula involving only arithmetical operations and roots.

• 1825 – Augustin-Louis Cauchy presents the Cauchy integral theorem for general integration paths—he assumes the function being integrated has a continuous derivative, and he introduces the theory of residues in complex analysis.

• 1825 – Peter Gustav Lejeune Dirichlet and Adrien-Marie Legendre prove Fermat's Last Theorem for \( n = 5 \).

• 1825 – André-Marie Ampère discovers Stokes' theorem.

• 1826 – Niels Henrik Abel gives counterexamples to Augustin-Louis Cauchy's purported “proof” that the pointwise limit of continuous functions is continuous.

• 1828 – George Green proves Green's theorem.

• 1829 – János Bolyai, Gauss, and Lobachevsky invent hyperbolic non-Euclidean geometry.

• 1831 – Mikhail Vasilievich Ostrogradsky redisCOVERS and gives the first proof of the divergence theorem earlier described by Lagrange, Gauss and Green.

• 1832 – Évariste Galois presents a general condition for the solvability of algebraic equations, thereby essentially founding group theory and Galois theory.

• 1832 – Lejeune Dirichlet proves Fermat's Last Theorem for \( n = 14 \).

• 1835 – Lejeune Dirichlet proves Dirichlet's theorem about prime numbers in arithmetical progressions.

• 1837 – Pierre Wantzel proves that doubling the cube and trisecting the angle are impossible with only a compass and straightedge, as well as the full completion of the problem of constructability of regular polygons.

• 1837 – Peter Gustav Lejeune Dirichlet develops Analytic number theory.

• 1838 – First mention of uniform convergence in a paper by Christoph Gudermann; later formalized by Karl Weierstrass. Uniform convergence is required to fix Augustin-Louis Cauchy erroneous “proof” that the pointwise limit of continuous functions is continuous from Cauchy’s 1821 Cours d'Analyse.

• 1841 – Karl Weierstrass discovers but does not publish the Laurent expansion theorem.

• 1843 – Pierre-Alphonse Laurent discovers and presents the Laurent expansion theorem.
• 1843 – William Hamilton discovers the calculus of quaternions and deduces that they are non-commutative.

• 1847 – George Boole formalizes symbolic logic in *The Mathematical Analysis of Logic*, defining what is now called Boolean algebra.

• 1849 – George Gabriel Stokes shows that solitary waves can arise from a combination of periodic waves.

• 1850 – Victor Alexandre Puiseux distinguishes between poles and branch points and introduces the concept of essential singular points.

• 1850 – George Gabriel Stokes rediscovers and proves Stokes' theorem.

• 1854 – Bernhard Riemann introduces Riemannian geometry.

• 1854 – Arthur Cayley shows that quaternions can be used to represent rotations in four-dimensional space.

• 1858 – August Ferdinand Möbius invents the Möbius strip.

• 1858 – Charles Hermite solves the general quintic equation by means of elliptic and modular functions.

• 1859 – Bernhard Riemann formulates the Riemann hypothesis, which has strong implications about the distribution of prime numbers.

• 1868 – Eugenio Beltrami demonstrates independence of Euclid’s parallel postulate from the other axioms of euclidian geometry.

• 1870 – Felix Klein constructs an analytic geometry for Lobachevski’s geometry thereby establishing its self-consistency and the logical independence of Euclid's fifth postulate.

• 1872 – Richard Dedekind invents what is now called the Dedekind Cut for defining irrational numbers, and now used for defining surreal numbers.

• 1873 – Charles Hermite proves that $e$ is transcendental.

• 1873 – Georg Frobenius presents his method for finding series solutions to linear differential equations with regular singular points.

• 1874 – Georg Cantor proves that the set of all real numbers is uncountably infinite but the set of all real algebraic numbers is countably infinite. His proof does not use his diagonal argument, which he published in 1891.

• 1882 – Ferdinand von Lindemann proves that $\pi$ is transcendental and that therefore the circle cannot be squared with a compass and straightedge.

• 1882 – Felix Klein invents the Klein bottle.

• 1895 – Diederik Korteweg and Gustav de Vries derive the Korteweg–de Vries equation to describe the development of long solitary water waves in a canal of rectangular cross section.

• 1895 – Georg Cantor publishes a book about set theory containing the arithmetic of infinite cardinal numbers and the continuum hypothesis.
• 1895 – Henri Poincaré publishes paper "Analysis Situs" which started modern topology.
• 1896 – Jacques Hadamard and Charles Jean de la Vallée-Poussin independently prove the prime number theorem.
• 1896 – Hermann Minkowski presents *Geometry of numbers*.
• 1899 – Georg Cantor discovers a contradiction in his set theory.
• 1899 – David Hilbert presents a set of self-consistent geometric axioms in *Foundations of Geometry*.
• 1900 – David Hilbert states his list of 23 problems, which show where some further mathematical work is needed.

**Contemporary**

**20th century**

• 1901 – Élie Cartan develops the exterior derivative.
• 1901 – Henri Lebesgue publishes on Lebesgue integration.
• 1903 – Carle David Tolmé Runge presents a fast Fourier transform algorithm
• 1903 – Edmund Georg Hermann Landau gives considerably simpler proof of the prime number theorem.
• 1908 – Ernst Zermelo axiomizes set theory, thus avoiding Cantor's contradictions.
• 1908 – Josip Plemelj solves the Riemann problem about the existence of a differential equation with a given monodromic group and uses Sokhotsky – Plemelj formulae.
• 1912 – Luitzen Egbertus Jan Brouwer presents the Brouwer fixed-point theorem.
• 1912 – Josip Plemelj publishes simplified proof for the Fermat's Last Theorem for exponent \( n = 5 \).
• 1915 – Emmy Noether proves her symmetry theorem, which shows that every symmetry in physics has a corresponding conservation law.
• 1916 – Srinivasa Ramanujan introduces Ramanujan conjecture. This conjecture is later generalized by Hans Petersson.
• 1919 – Viggo Brun defines Brun’s constant \( B_2 \) for twin primes.
• 1921 – Emmy Noether introduces the first general definition of a commutative ring.
• 1928 – John von Neumann begins devising the principles of game theory and proves the minimax theorem.
• 1929 – Emmy Noether introduces the first general representation theory of groups and algebras.
• 1930 – Casimir Kuratowski shows that the three-cottage problem has no solution.
• 1930 – Alonzo Church introduces Lambda calculus.
• 1931 – Kurt Gödel proves his incompleteness theorem, which shows that every axiomatic system for mathematics is either incomplete or inconsistent.
• 1931 – Georges de Rham develops theorems in cohomology and characteristic classes.
• 1933 – Karol Borsuk and Stanislaw Ulam present the Borsuk–Ulam antipodal-point theorem.
• 1933 – Andrey Nikolaevich Kolmogorov publishes his book *Basic notions of the calculus of probability* (*Grundbegriffe der Wahrscheinlichkeitsrechnung*), which contains an axiomatization of probability based on measure theory.
• 1938 – Tadeusz Banachiewicz introduces LU decomposition.
• 1940 – Kurt Gödel shows that neither the continuum hypothesis nor the axiom of choice can be disproven from the standard axioms of set theory.
• 1942 – G.C. Danielson and Cornelius Lanczos develop a fast Fourier transform algorithm.
• 1943 – Kenneth Levenberg proposes a method for nonlinear least squares fitting.
• 1945 – Stephen Cole Kleene introduces realizability.
• 1945 – Saunders Mac Lane and Samuel Eilenberg start category theory.
• 1945 – Norman Steenrod and Samuel Eilenberg give the Eilenberg–Steenrod axioms for (co-)homology.
• 1946 – Jean Leray introduces the Spectral sequence.
• 1948 – Atle Selberg and Paul Erdős prove independently in an elementary way the prime number theorem.
• 1949 – John Wrench and L.R. Smith compute π to 2,037 decimal places using ENIAC.
• 1949 – Claude Shannon develops notion of Information Theory.
• 1950 – Stanislaw Ulam and John von Neumann present cellular automata dynamical systems.
• 1953 – Nicholas Metropolis introduces the idea of thermodynamic simulated annealing algorithms.
• 1955 – H. S. M. Coxeter et al. publish the complete list of uniform polyhedra.
• 1955 – Enrico Fermi, John Pasta, Stanislaw Ulam, and Mary Tsingou numerically study a nonlinear spring model of heat conduction and discover solitary wave type behavior.
• 1956 – Noam Chomsky describes a hierarchy of formal languages.
• 1956 – John Milnor discovers the existence of an Exotic sphere in seven dimensions, inaugurating the field of differential topology.
• 1957 – Kiyosi Itô develops Itô calculus.
• 1957 – Stephen Smale provides the existence proof for crease-free sphere eversion.
• 1959 – Kenkichi Iwasawa creates Iwasawa theory.
• 1960 – C. A. R. Hoare invents the quicksort algorithm.
• 1960 – Irving S. Reed and Gustave Solomon present the Reed–Solomon error-correcting code.
• 1961 – Daniel Shanks and John Wrench compute $\pi$ to 100,000 decimal places using an inverse-tangent identity and an IBM-7090 computer.
• 1961 – John G. F. Francis and Vera Kublanovskaya independently develop the QR algorithm to calculate the eigenvalues and eigenvectors of a matrix.
• 1961 – Stephen Smale proves the Poincaré conjecture for all dimensions greater than or equal to 5.
• 1962 – Donald Marquardt proposes the Levenberg–Marquardt nonlinear least squares fitting algorithm.
• 1963 – Paul Cohen uses his technique of forcing to show that neither the continuum hypothesis nor the axiom of choice can be proven from the standard axioms of set theory.
• 1963 – Martin Kruskal and Norman Zabusky analytically study the Fermi–Pasta–Ulam–Tsingou heat conduction problem in the continuum limit and find that the KdV equation governs this system.
• 1963 – meteorologist and mathematician Edward Norton Lorenz published solutions for a simplified mathematical model of atmospheric turbulence – generally known as chaotic behaviour and strange attractors or Lorenz Attractor – also the Butterfly Effect.
• 1965 – Iranian mathematician Lotfi Asker Zadeh founded fuzzy set theory as an extension of the classical notion of set and he founded the field of Fuzzy Mathematics.
• 1965 – Martin Kruskal and Norman Zabusky numerically study colliding solitary waves in plasmas and find that they do not disperse after collisions.
• 1965 – James Cooley and John Tukey present an influential fast Fourier transform algorithm.
• 1966 – E. J. Putzer presents two methods for computing the exponential of a matrix in terms of a polynomial in that matrix.
• 1966 – Abraham Robinson presents non-standard analysis.
• 1967 – Robert Langlands formulates the influential Langlands program of conjectures relating number theory and representation theory.
• 1968 – Michael Atiyah and Isadore Singer prove the Atiyah–Singer index theorem about the index of elliptic operators.
• 1973 – Lotfi Zadeh founded the field of fuzzy logic.
• 1974 – Pierre Deligne solves the last and deepest of the Weil conjectures, completing the program of Grothendieck.
• 1975 – Benoît Mandelbrot publishes *Les objets fractals, forme, hasard et dimension*.
• 1976 – Kenneth Appel and Wolfgang Haken use a computer to prove the Four color theorem.
1981 – Richard Feynman gives an influential talk "Simulating Physics with Computers" (in 1980 Yuri Manin proposed the same idea about quantum computations in "Computable and Uncomputable" (in Russian)).

1983 – Gerd Faltings proves the Mordell conjecture and thereby shows that there are only finitely many whole number solutions for each exponent of Fermat's Last Theorem.

1985 – Louis de Branges de Bourcia proves the Bieberbach conjecture.

1986 – Ken Ribet proves Ribet's theorem.

1987 – Yasumasa Kanada, David Bailey, Jonathan Borwein, and Peter Borwein use iterative modular equation approximations to elliptic integrals and a NEC SX-2 supercomputer to compute $\pi$ to 134 million decimal places.

1991 – Alain Connes and John W. Lott develop non-commutative geometry.

1992 – David Deutsch and Richard Jozsa develop the Deutsch–Jozsa algorithm, one of the first examples of a quantum algorithm that is exponentially faster than any possible deterministic classical algorithm.

1994 – Andrew Wiles proves part of the Taniyama–Shimura conjecture and thereby proves Fermat's Last Theorem.


1995 – Simon Plouffe discovers Bailey–Borwein–Plouffe formula capable of finding the $n$th binary digit of $\pi$.

1998 – Thomas Callister Hales (almost certainly) proves the Kepler conjecture.

1999 – the full Taniyama–Shimura conjecture is proven.

2000 – the Clay Mathematics Institute proposes the seven Millennium Prize Problems of unsolved important classic mathematical questions.

21st century

2002 – Manindra Agrawal, Nitin Saxena, and Neeraj Kayal of IIT Kanpur present an unconditional deterministic polynomial time algorithm to determine whether a given number is prime (the AKS primality test).

2002 – Yasumasa Kanada, Y. Ushiro, Hisayasu Kuroda, Makoto Kudoh and a team of nine more compute $\pi$ to 1241.1 billion digits using a Hitachi 64-node supercomputer.

2002 – Preda Mihăilescu proves Catalan's conjecture.

2003 – Grigori Perelman proves the Poincaré conjecture.

2004 – the classification of finite simple groups, a collaborative work involving some hundred mathematicians and spanning fifty years, is completed.
2004 – Ben Green and Terence Tao prove the Green-Tao theorem.
2007 – a team of researchers throughout North America and Europe used networks of computers to map $E_8$.
2009 – Fundamental lemma (Langlands program) had been proved by Ngô Bảo Châu.
2010 – Larry Guth and Nets Hawk Katz solve the Erdős distinct distances problem.
2013 – Yitang Zhang proves the first finite bound on gaps between prime numbers.
2014 – Project Flyspeck announces that it completed proof of Kepler's conjecture.
2014 – Using Alexander Yee's y-cruncher "houkouonchi" successfully calculated $\pi$ to 13.3 trillion digits.
2015 – Terence Tao solved The Erdős Discrepancy Problem
2015 – László Babai found that a quasipolynomial complexity algorithm would solve the Graph isomorphism problem
2016 – Using Alexander Yee's y-cruncher Peter Trueb successfully calculated $\pi$ to 22.4 trillion digits
2019 – using y-cruncher v0.7.6 Emma Haruka Iwao calculated $\pi$ to 31.4 trillion digits.

Timeline of zoology

Ancient world

- 28000 BC. Cave painting (e.g. Chauvet Cave) in but, especially Spain, depict animals in a stylized fashion. Mammoths (the same species later to be seen thawing from ice in Siberia) were depicted in these European cave paintings.
- 10000 BC. Man ($Homo sapiens$) domesticated dogs, pigs, sheep, goats, fowl, and other animals in Europe, northern Africa and the Near East.
- 6500 BC. The aurochs, ancestor of domestic cattle, would be domesticated in the next two centuries if not earlier (Obre I, Yugoslavia). This fierce beast was the last major food animal to be tamed for use as a source of milk, meat, power, and leather in the Old World.
- 3500 BC. Sumerian animal-drawn wheeled vehicles and plows are developed in Mesopotamia, the region called the "Fertile Crescent" by U.S. archaeologist James Henry Breasted (1865–1935). Irrigation may also have used animal power. By increasing the area under cultivation and reducing the number of people required to raise food, society will permit a few people to become priests, artisans, scholars, and merchants. Since Sumeria had no natural defenses, armies with mounted cavalry and chariots became imperative and were a scourge upon the land they purported to protect. Civilization was thus built on the backs of equines (horses and asses).
- 2000 BC. Domestication of the silkworm in China.
- 1100 BC. Won Chang (China), first of the Chou emperors, stocked his imperial zoological garden with deer, goats, birds and fish from many parts of the world. Like zoos today, the animals may have been seen as exotic, alien, and possibly threatening. The emperor also enjoyed sporting events with the use of animals.
- 850 BC. Homer (Greek), reputedly a blind poet, wrote the epics Iliad and Odyssey. Both contain animals as monsters and metaphors (gross soldiers turned into pigs by the witch Circe), but also some correct observations on bees and fly maggots. Both epics make reference to mules. The ancient Greeks considered horses so highly that they "hybridized" them with humans, to form boisterous centaurs. At any rate, animals are used as metaphors and moral symbols by Homer to make a timeless story.
- 610 BC. Anaximander (Greek, 610 BC–545 BC) was a student of Thales of Miletus. The first life, he taught, was formed by spontaneous generation in the mud. Later animals came into being by transmutations, left the water, and reached dry land. Man was derived from lower animals, probably aquatic. His writings, especially his poem *On Nature*, were read and cited by Aristotle and other later philosophers, but are lost.
- 563? BC. Buddha (Indian, 563?–483 BC) had gentle ideas on the treatment of animals. Animals are held to have intrinsic worth, not just the values they derive from their usefulness to man.
- 500 BC. Empedocles of Agrigentum (Greek, 504–433 BC) reportedly rid a town of malaria by draining nearby swamps. He proposed the theory of the four humors and a natural origin of living things.
- 500 BC. Alcmaeon (Greek, c. 500 BC) performed human dissections. He identified the optic nerve, distinguished between veins and arteries, and showed that the nose was not connected to the brain. He made much of the tongue and explained how it functioned. He also gave an explanation for semen and for sleep.
- 500 BC. Xenophanes (Greek, 576–460 BC), a disciple of Pythagoras (?–497 BC), first recognized fossils as animal remains and inferred that their presence on mountains indicated the latter had once been beneath the sea. "If horses or oxen had hands and could draw or make statues, horses would represent the forms of gods as horses, oxen as oxen." Galen (130?–201?) revived interest in fossils that had been rejected by Aristotle, and the speculations of Xenophanes were again viewed with favor.
- 470 BC. Democritus of Abdera (Greek, 470–370 BC) made dissections of many animals and humans. He was the first Greek philosopher-scientist to propose a classification of animals, dividing them into blooded animals (Vertebrata) and bloodless animals (Evertebrata). He also held that lower animals had perfected organs and that the brain was the seat of thought.
- 460 BC. Hippocrates (Greek, 460?–377? BC), the "Father of Medicine", used animal dissections to advance human anatomy. Fifty books attributed to him were assembled in Alexandria in the 3rd century BC. These probably represent the works of several authors, but the treatments given are usually conservative.
- 440 BC. Herodotus of Halikarnassos (Greek, 484–425 BC) treated exotic fauna in his *Historia*, but his accounts are often based on tall tales. He explored the Nile, but much of ancient Egyptian civilization was already lost to living memory by his time.

- 384 BC. Aristotle (Greek, 384–322 BC) studied under Plato, but he was not reluctant to disagree with the master. His books *Historia Animalium* (9 books), *De Partibus Animalium*, and *De Generatione Animalium* set the zoological stage for centuries. He emphasized the value of direct observation, recognized law and order in biological phenomena, and derived conclusions inductively from observed facts. He believed that there was a natural scale that ran from simple to complex. He made advances in the area of marine biology, basing his writings on keen observation and rational interpretation as well as conversations with local Lesbos fishermen for two years, beginning in 344 BC. His account of male protection of eggs by the barking catfish was scorned for centuries until Louis Agassiz confirmed Aristotle's description. Aristotle's botanical works are lost, but those of his botanical student Theophrastos of Eresos (372–288 BC) are still available (*Inquiry into Plants*).

- 340 BC. Plato (Greek, 427–347 BC) held that animals existed to serve man, but they should not be mistreated because this would lead people to mistreat other people. Others who have echoed this opinion are St. Thomas Aquinas, Immanuel Kant, and Albert Schweitzer.

- 323 BC. Alexander the Great (Macedonian, 356–323 BC) collected animals, some perhaps for his old teacher Aristotle, when he was not busy conquering the known world. He is credited with the introduction of the peacock into Europe. Aside from its decorative tail feathers, the peacock (a pheasant) was eaten regularly by Europeans until the arrival of the turkey. (Charlemagne is said to have served thousands at a single bash.)

- 95 BC. Lucretius (Titus Lucretius Carus) (Roman, 96?–55 BC) spent his whole life writing one poem (still unfinished), called *De Rerum Natura*, with a version of the atomic theory, a theory of heredity, etc.

- 70 BC. Publius Vergilius Maro (Virgil) (70–19 BC) was a famous Roman poet. His poems *Bucolics* (42–37 BC) and *Georgics* (37–30 BC) hold much information on animal husbandry and farm life. His *Aeneid* (published posthumously) has many references to the zoology of his time.

- 36 BC. Marcus Terentius Varro (116–27 BC) wrote *De Re Rustica*, a treatise that includes apiculture. He also treated the problem of sterility in the mule and recorded a rare instance in which a fertile mule was bred.

- 50. Lucius Annaeus Seneca (Roman, 4 BC–AD 65), tutor to Roman emperor Nero, maintained that animals have no reason, just instinct, a "stoic" position. He remarked on the ability of glass globes filled with water to magnify small objects.

- 77. Pliny the Elder (Roman, 23–79) wrote his *Historia Naturalis* in 37 volumes. This work is a catch-all of zoological folklore, superstitions, and some good observations.
• 79. Pliny the Younger (Roman, 62–113), nephew of Pliny the Elder, inherited his uncle's notes and wrote on beekeeping.

• 100. Plutarch (Roman, 46?–120) stated that animals' behavior is motivated by reason and understanding. Life of the ant mirrors the virtues of friendship, sociability, endurance, courage, moderation, prudence, and justice.

• 131. Galen of Pergamum (Greek, 131?–201?), physician to Roman Emperor Marcus Aurelius, wrote on human anatomy from dissections of animals. His texts were used for hundreds of years, gaining the reputation of infallibility.

• 200 c. Various compilers in post-classical and medieval times added to the Physiologus (or, more popularly, the Bestiary), the major book on animals for hundreds of years. Animals were believed to exist in order to serve man, if not as food or slaves then as moral examples.

**Middle Ages**

• 600 c. Isidorus Hispalensis (Spanish bishop of Seville) (560–636) wrote *Origines sive Etymologiae*, a compendium on animals that served until the rediscovery of Aristotle and Pliny. Full of errors, it nevertheless was influential for hundreds of years. He also wrote *De Natura Rerum*.

• 781. Al-Jahiz (Afro-Arab, 781–868/869), a scholar at Basra, wrote on the influence of environment on animals.

• 901. Horses came into wider use in those parts of Europe where the three-field system produces grain surpluses for feed, but hay-fed oxen were more economical, if less efficient, in terms of time and labor and remained almost the sole source of animal power in southern Europe, where most farmers continued to use the two-field system.

• 1114. Gerard of Cremona (1114–1187), after the capture of Toledo and its libraries from the Moors, translated Ptolemy, Aristotle, Euclid, Hippocrates, Galen, Pliny and many other classical authors from the Arabic.

• 1244–1248. Frederick II von Hohenstaufen (Holy Roman Emperor) (1194–1250) wrote *De Arte Venandi cum Avibus* (The Art of Hunting with Birds) as a practical guide to ornithology. Hawking was the sport for royalty in those days.

• 1244. Vincentius Bellovacensis (Vincent of Beauvais) (?–1264) wrote *Speculum Quadruplex Naturale, Doctrinal, Morale, Historiale* (1244–1254), a major encyclopedia of the 13th century. This work comprises three huge volumes, of 80 books and 9,885 chapters.

• 1248. Thomas of Cantimpré, (Fleming, 1204?–1275?) wrote *Liber de Natura Rerum*, a major 13th-century encyclopedia.
• 1254–1323. Marco Polo (Italian, 1254–1323) provided information on Asiatic fauna, revealing new animals to Europeans. "Unicorns" (rhinos?) were reported from southern China, but fantastic animals were otherwise not included.

• 1255–1270. Albertus Magnus of Cologne (Bavarian, 1206?–1280) (Albert von Bollstaedt or St. Albert) wrote De Animalibus. He promoted Aristotle but also included new material on the perfection and intelligence of animals, especially bees.

• 1304–1309. Petrus de Crescentii wrote Ruralum Commodorum, a practical manual for agriculture with many accurate observations on insects and other animals. Apiculture was discussed at length.

• 1453. The fall of Constantinople to the Turks ended the Byzantine Empire. Greek manuscripts became known in Europe, including books by Aristotle and Theophrastos that were translated into Latin by Theodore Gaza (Greek, ?–1478).

• 1492–1555. Edward Wotton (English, 1492–1555) wrote De Differentiis Animalium, a well thought-out work that influenced Gesner.

• 1492. Christopher Columbus (Italian) arrives in the New World. New animals soon begin to overload European zoology. Columbus is said to have introduced cattle, horses, and eight pigs from the Canary Islands to Hispaniola in 1493, giving rise to virtual devastation of that and other islands. Pigs were often set ashore by sailors to provide food on the ship's later return. Feral populations of hogs were often dangerous to humans.

• 1500 c. Paracelsus (Theophrastus Bambastus von Hohenheim) (Swiss or German?, 1493–1541), alchemist, wrote that poisons should be used against disease: he recommended mercury for treating syphilis.

• 1519–1520. Bernal Diaz del Castillo (Spanish, 1450?–1500), chronicler of Cortez's conquest of Mexico, commented on the zoological gardens of Aztec ruler Montezuma (1466–1520), a marvel with parrots, rattlesnakes, etc.

• 1523. Gonzalo Fernández de Oviedo y Valdés (Spanish, 1478–1557), appointed official historiographer of the Indies in 1523, wrote Sumario de la Natural Historia delas Indias (Toledo, 1527). He was the first to describe many New World animals, such as the tapir, opossum, manatee, iguana, armadillo, ant-eaters, sloth, pelican, humming birds, etc.

Modern world

• 1551–1555. Pierre Belon (French, 1517–1564) wrote L'Histoire Naturelle des Estranges Poissons Marins (1551) and La Nature et Diversité des Poissons (1555). This latter work included 110 animal species and offered many new observations and corrections to Herodotus. L'Histoire de la nature des oyseaux avec leurs descriptions et naïfs portraicts (1555) was his picture book, with improved animal classification and accurate anatomical drawings. In this he published a man's and a bird's skeleton side by
side to show the resemblance. He discovered an armadillo shell in a market in Syria, showing how Islam was distributing the finds from the New World.

- 1551. Conrad Gessner (Swiss, 1516–1565) wrote *Historia animalium* (Tiguri, 4 vols., 1551–1558, last volume published in 1587) and gained renown. This work, although uncritically compiled in places, was consulted for over 200 years. He also wrote *Icones animalum* (1553) and *Thierbuch* (1563).

- 1554–1555. Guillaume Rondelet (French, 1507–1566) wrote *Libri de piscibus marinis* (1554) and *Universe aquatilium historia* (1555). He gathered vernacular names in hope of being able to identify the animal in question. He did go to print with discoveries that disagreed with Aristotle.

- 1574. Johannes Faber (1576–1629), an early entomologist and member of the Accademia dei Lincei in Rome, gave the microscope its name.

- 1578. Jean de Lery (French, 1534–1611) was a member of the French colony at Rio de Janeiro. He published *Voyage en Amerique avec la description des animaux et plantes de ce pays* (1578) with observations on the local fauna.

- 1585. Thomas Harriot (English, 1560–1621) was a naturalist with the first attempted English colony in North America, on Roanoke Island, North Carolina. His *Brief and True Report of the New Found Land of Virginia* (1590) describes the black bear, gray squirrel, hare, otter, opossum, raccoon, skunk, Virginia and mule deer, turkeys, horseshoe crab (*Limulus*), etc.

- 1589. José de Acosta (Spanish, 1539–1600) wrote *De Natura Novi Orbis Libri duo* (1589) and *Historia Natural y Moral de las Indias* (1590), describing many previously unknown animals from the New World.

17th century

- 1600. In Italy a spider scare lead to hysteria and the tarantella dance by which the body cures itself through physical exertions.

- 1602. Ulysses Aldrovandi (Italian, 1522–1605) wrote *De Animalibus Insectis*. This and his other works include much nonsense, but he used wing and leg morphology to construct his classification of insects. He is more highly regarded for his ornithological contributions.

- 1604–1614. Francisco Hernández de Toledo (Spanish) was sent to study Mexican biota in 1593–1600, by Philip II of Spain. His notes were published in Mexico in 1604 and 1614, describing many animals for the first time: coyote, buffalo, axolotl, porcupine, pronghorn antelope, horned lizard, bison, peccary and the toucan. He also figured many animals for the first time: ocelot, rattlesnake, manatee, alligator, armadillo, and the pelican.

- 1607 (1612?). Captain John Smith (English), head of the Jamestown colony, wrote *A Map of Virginia* in which he describes the physical features of the country, its climate, plants and animals, and inhabitants. He describes the raccoon, muskrat, flying squirrel, as well as a score of animals, all well identifiable. (In 1609
the Jamestown, Virginia, colony was almost lost when settlers found that their stores had been devoured by rats from English ships.)

- 1617. Garcilaso de la Vega (Peruvian Spanish, 1539–1617) wrote *Royal Commentaries of Peru*, containing descriptions of the condor, ocelots, puma, viscacha, tapir, rhea, skunk, llama, huanaco, paca, and vicuña.

- 1620? North American colonists probably introduced the European honeybee, *Apis mellifera*, into Virginia. By the 1640s these insects were also in Massachusetts. They became feral and advanced through eastern North America before the settlers.

- 1628. William Harvey (English, 1578–1657) published *Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus* (1628) with the doctrine of the circulation of blood (an inference made by him in about 1616).

- 1634. William Wood (English) wrote *New England Prospect* (1634) in which he describes New England's fauna.

- 1637. Thomas Morton (English, c. 1579–1647) wrote *New English Canaan* (1637) with treatments of 26 species of mammals, 32 birds, 20 fishes and 8 marine invertebrates.

- 1648. Georg Marcgrave (–1644) was a German astronomer working for Johann Moritz, Count Maurice of Nassau, in the Dutch colony set up in northeastern Brazil. His *Historia Naturalis Brasiliae* (1648) contains the best early descriptions of many Brazilian animals. Marcgrave used Tupi names that were later Latinized by Linnaeus in the 13th edition of the *Systema Naturae*. The biological and linguistic data could have come from Moraes, a Brazilian Jesuit priest turned apostate.

- 1651. William Harvey published *Exercitationes de Generatione Animalium* (1651) with the aphorism *Ex ovo omnia* on the title page.

- 1661. Marcello Malpighi (Italian, 1628–1694) discovered capillaries (1661), structures predicted to exist by Harvey some thirty years earlier. Malpighi was the founder of microanatomy. He studied, among other things, the anatomy of the silkworm (1669) and the development of the chick (1672).

- 1662. John Graunt (English) provided the beginnings of demography with his *Natural and Political Observations ... made upon the Bills of Mortality* (1662). His speculations on Adam's and Eve's descendants and their growth rates showed an understanding of geometrical population increase. He found that more males than females were born, a fact considered by Sir Matthew Hale as providential for the "needs of warfare".

- 1665. Robert Hooke (English, 1635–1703) wrote *Micrographia* (1665, 88 plates), with his early microscopic studies. He coined the term "cell".

- 1668. Francesco Redi (Italian, 1621–1697) wrote *Esperienze Intorno alla Generazione degli Insetti* (1668) and *De animaculis vivis quae in corpribus animalium vivorum reperiuntur* (1708). His refutation of spontaneous generation in flies is still considered a model in experimentation.
1669. Jan Swammerdam (Dutch, 1637–1680) wrote *Historia Insectorum Generalis* (1669) describing metamorphosis in insects and supporting the performance doctrine. He was a pioneer in microscopic studies. He gave the first description of red blood corpuscles and discovered the valves of lymph vessels. His work was unknown and unacknowledged until after his death.

1672. Regnier de Graaf (1641–1673) reported that he had traced the human egg from the ovary down the fallopian tube to the uterus. What he really saw was the follicle.

1675–1722. Antonie van Leeuwenhoek (Dutch, 1632–1723) wrote *Arcana Naturae Detectae Ope Microscopiorum Delphis Batavorum*, a treatise with early observations made with microscopes. He discovered blood corpuscles, striated muscles, human spermatozoa (1677), protozoa (1674), bacteria (1683), rotifers, etc.

1691. John Ray (English, 1627–1705) wrote *Synopsis methodica animalium quadripedum* (1693), *Historia Insectorum* (1710), and *The Wisdom of God Manifested in the Works of the Creation* (1691). He tried to classify different animal species into groups largely according to their toes and teeth.

1699. Edward Tyson (English, 1650–1708) wrote *Orang-Outang sive Homo Sylvestris* (or *Anatomy of a Pygmie Compared with that of a Monkey, an Ape and a Man*) (1699), his anatomical study of the primate. This was the first detailed and accurate study of the higher apes. Other studies by Tyson include the female porpoise, male rattlesnake, tapeworm, roundworm (*Ascaris*), peccary and opossum.

1700? Discovery of the platypus in Australia.

1700. Félix de Azara (Spanish) estimated the feral herds of cattle on the South American pampas at 48 million animals. These animals probably descended from herds introduced by the Jesuits some 100 years earlier. (North America and Australia were to follow in this pattern, where feral herds of cattle and mustangs would explode, become pests, and reform the frontier areas.)

1705. Maria Sybilla Merian (German, 1647–1717) wrote and beautifully illustrated her *Metamorphosis insectorum surinamensis* (*Veranderingen der Surinaamsche Insecten*) (1705). In this book she stated that *Fulgora lanternaria* was luminous.

1730? Sir Hans Sloane (English (born Ireland), 1660–1753) was a founder of the British Museum.

1734–1742. René Antoine Ferchault de Réaumur (French, 1683–1756) was an early entomologist. His *Mémoires pour servir ... l'histoire des insectes* (6 volumes) shows the best of zoological observation at the time. He invented the glass-fronted bee hive.

1740. Abraham Trembley, Swiss naturalist, discovered the hydra which he considered to combine both animal and plant characteristics. His *Mémoires pour Servir ... l'Histoire d'un Genre de Polypes d'Eau Douce ... Bras en Terme de Cornes* (1744) showed that freshwater polyps of *Hydra* could be sectioned or
mutilated and still reform. Regeneration soon became a topic of inquiry among Réaumur, Bonnet, Spallanzini and others.

- **1745.** Charles Bonnet (French-Swiss, 1720–1793) wrote *Traité d'Insectologie* (1745) and *Contemplation de la nature* (1732). He confirmed parthenogenesis of aphids.

- **1745.** Pierre Louis M. de Maupertuis (French, 1698–1759) went to Lapland to measure the arc of the meridian (1736–1737). Maupertuis was a Newtonian. He generated family trees for inheritable characteristics (e.g., haemophilia in European royal families) and showed inheritance through both the male and female lines. He was an early evolutionist and head of the Berlin Academy of Sciences. In 1744 he proposed the theory that molecules from all parts of the body were gathered into the gonads (later called "pangenesis"). *Vénus physique* was published anonymously in 1745. Maupertuis wrote *Essai de cosmologie* in which he suggests a survival of the fittest concept: "Could not one say that since, in the accidental combination of Nature's productions, only those could survive which found themselves provided with certain appropriate relationships, it is no wonder that these relationships are present in all the species that actually exist? These species which we see today are only the smallest part of those which a blind destiny produced."

- **1748.** John Tuberville Needham, an English naturalist, wrote *Observations upon the Generation, Composition, and Decomposition of Animal and Vegetable Substances* in which he offers "proof" of spontaneous generation. Needham found flasks of broth teeming with "little animals" after having boiled them and sealed them, but his experimental techniques were faulty.

- **1748–1751.** Peter Kalm (Swede) was a naturalist and student of Linnaeus. He traveled in North America (1748–1751).

- **1749–1804.** Georges-Louis Leclerc, Comte de Buffon (French, 1707–1788) wrote *Histoire Naturelle* (1749–1804 in 44 vols.) that had a great impact on zoology. He asserted that species were mutable. Buffon also drew attention to vestigial organs. He held that spermatozoa were "living organic molecules" that multiplied in the semen.

- **1758.** Albrecht von Haller (Swiss, 1708–1777) was one of the founders of modern physiology. His work on the nervous system was revolutionary. He championed animal physiology, along with human physiology. See his textbook *Elementa Physiologiae Corporis Humani* (1758).

- **1758.** Carl Linnaeus (Swedish, 1707–1778) published the *Systema Naturae* whose tenth edition (1758) is the starting point of binomial nomenclature for zoology.

- **1759.** Caspar Friedrich Wolff (1733–1794) wrote *Theoria Generationis* (1759) that disagreed with the idea of preformation. He supported the doctrine of epigenesis. A youthful follower of the German philosopher Gottfried Wilhelm von Leibniz (1646–1716), Wolff sought to resolve the problem of hybrids (mule, hinny, apemen) in his epigenesis, since these could not be well explained by performation.
• 1768. Sir Joseph Banks (1743–1820) and Daniel Solander (1733–1782) sailed with Captain James Cook (English, 1728–1779) on the H.M.S. Endavour for the South Seas (Tahiti), until 1771.

• 1769. Edward Bancroft (English) wrote An Essay on the Natural History of Guyana in South America (1769) and advanced the theory that flies transmit disease.

• 1771. Johann Reinhold Forster (German, 1729–1798) was the naturalist on Cook's second voyage around the world (1772–1775). He published a Catalogue of the Animals of North America (1771) as an addendum to Kalm's Travels. He also studied the birds of Hudson Bay.

• 1774. Gilbert White (English) wrote The natural history and antiquities of Selborne, in the county of Southampton (1774) with fine ornithological observations on migration, territoriality and flocking.

• 1775. Johan Christian Fabricius (Danish, 1745–1808) wrote Systema Entomologiae (1775), Genera Insectorum (1776), Philosophia Entomologica (1778), Entomologia Systematica (1792–1794, in six vols.), and later publications (to 1805), to make Fabricius one of the world's greatest entomologists.

• 1776. René Dutrochet (French, 1776–1832) proposed an early version of the cell theory.

• 1780. Lazaro Spallanzani (Italian, 1729–1799) performed artificial fertilization in the frog, silkmoth and dog. He concluded from filtration experiments that spermatozoa were necessary for fertilization. In 1783 he showed that human digestion was a chemical process since gastric juices in and outside the body liquefied food (meat). He used himself as the experimental animal. His work to disprove spontaneous generation in microbes was resisted by John Needham (English priest, 1713–1781).

• 1780. Antoine Lavoisier (French, 1743–1794) and Pierre Laplace (French, 1749–1827) wrote Memoir on heat. Animal respiration was a form of combustion, a conclusion reached by this discoverer of Oxygen.

• 1783–1792. Alexandre Rodrigues Ferreira (Brazilian) undertook biological exploration. He wrote Viagem Filosófica pelas Captanias do Grão-Pará, Rio Negro, Mato Grosso e Cuiabá. His specimens were taken by Saint-Hilaire from Lisbon to the Paris Museum during the Napoleonic invasion of Portugal. He is considered the "Brazilian Humboldt".

• 1784. Johann Wolfgang von Goethe (German) wrote Erster Entwurf einer Einleitung in die vergleichende Anatomie (1795) that promoted the idea of archetypes to which animals should be compared. Vitalist and romantic, his zoology mostly follows Lorenz Oken.

• 1784. Thomas Jefferson (American) wrote Notes on the State of Virginia (1784) that refuted some of Buffon's mistakes about New World fauna. As U.S. President, he dispatched the Lewis and Clark expedition to the American West (1804).

• 1789? Guillaume Antoine Olivier (French, 1756–1814) wrote Entomologie, or Histoire Naturelle des Insectes (1789).

• 1789. George Shaw & Frederick Polydore Nodder published The Naturalist's Miscellany: or coloured figures of natural objects drawn and described immediately from nature (1789–1813) in 24 volumes with hundreds of color plates.
• 1792. François Huber made original observations on honeybees. In his *Nouvelles Observations sur les Abeilles* (1792) he noted that the first eggs laid by queen bees develop into drones if her nuptial flight had been delayed and that her last eggs would also give rise to drones. He also noted that rare worker eggs develop into drones. This anticipated by over 50 years the discovery by Jan Dzierżon that drones come from unfertilized eggs and queen and worker bees come from fertilized eggs.

• 1793. Lazaro Spallanzani (Italian, 1729–1799) conducted experiments on the orientation of bats and owls in the dark.

• 1793. Christian Konrad Sprengel (1750–1816) wrote *Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen* (1793) that was a major work on insect pollination of flowers, previously discovered in 1721 by Philip Miller (1694–1771), the head gardener at Chelsea and author of the famous *Gardener's Dictionary* (1731–1804).

• 1794. Erasmus Darwin (English, grandfather of Charles Darwin) wrote *Zoönomia, or the Laws of Organic Life* (1794) in which he advanced the idea that environmental influences could transform species.

• 1795. James Hutton (English) wrote *Theory of the Earth* (1795) in which he interpreted certain geological strata as former sea beds.

• 1796–1829. Pierre André Latreille (French, 1762–1833) sought to provide a "natural" system for the classification of animals, in his many monographs on invertebrates. *Insectes de l'Amerique Equinoxiale* (1811) was devoted to insects collected by Humboldt and Bonpland.

• 1798. Thomas Robert Malthus (English, 1766–1834) wrote *Essay on the Principle of Population* (1798), a book that was important to both Darwin and Wallace.

• 1799. George Shaw (English) provided the first description of the duck-billed platypus. Everard Home (1802) provided the first complete description.

• 1799–1803. Alexander von Humboldt (German, 1769–1859) and Aimé Jacques Alexandre Goujaud Bonpland (French) arrived in Venezuela in 1799. Humboldt's *Personal Narrative of Travels to the Equinoctial Regions of America during the years 1799–1803* and *Kosmos* were very influential in his time and since.

• 1799. Georges Cuvier (French, 1769–1832) established comparative anatomy as a field of study. He also founded the science of paleontology. He wrote *Leçons d'Anatomie Comparée* (1801–1805), *Le Règne Animal distribué d'après son organisation* (1816), *Ossemens Fossiles* (1812–1813). He believed in the fixity of species and the Biblical Flood. His early *Tableau élémentaire de l'histoire naturelle des animaux* (1798) was influential, but it did not include Cuvier's major contributions to animal classification.

• 1799. American hunters killed the last bison in the American East, in Pennsylvania.
19th century

- 1802. Jean-Baptiste de Lamarck (French, 1744–1829) wrote *Recherches sur l'Organisation des Corps Vivants* and *Philosophie zoologique* (1809). He was an early evolutionist and organized invertebrate paleontology. While Lamarck's contributions to science include work in meteorology, botany, chemistry, geology, and paleontology, he is best known for his work in invertebrate zoology and his theoretical work on evolution. He published an impressive seven-volume work, *Histoire naturelle des animaux sans vertébres* ("Natural history of animals without backbones"; 1815–1822).

- 1813–1818. William Charles Wells (Scottish-American, 1757–1817) was the first to recognize the principle of natural selection. He read a paper to the Royal Society in 1813 (but not published until 1818) which used the idea to explain differences between human races. The application was limited to the question of how different skin colours arose.

- 1815. William Kirby and William Spence (English) wrote *An Introduction to Entomology* (first edition in 1815). This was the first modern entomology text.


- 1817. William Smith, in his *Stratigraphical System of Organized Fossils* (1817) showed that certain strata have characteristic series of fossils.

- 1817. Thomas Say (American, 1787–1834) was a brilliant young systematic zoologist until he moved to the utopian community at New Harmony, Indiana, in 1825. Luckily, most of his insect collections have been recovered.

- William Lawrence (English, 1783–1867) published a book of his lectures to the Royal College of Surgeons in 1819. The book contains a remarkably clear rejection of Lamarckism (soft inheritance), protorevolutionary ideas about the origin of mankind, and a forthright denial of the 'Jewish scriptures' (= Old Testament). He was forced to suppress the book after the Lord Chancellor refused copyright and other powerful men made threatening remarks. His subsequent life was highly successful.

- 1824. The Royal Society for the Prevention of Cruelty to Animals (RSPCA) is founded at London.

- 1825. Gideon Mantell (English) wrote "Notice on the *Iguanodon*, a newly discovered fossil reptile, from the sandstone of Tilgate Forest, in Sussex" (Phil. Trans. Roy, Soc. Lond., 115: 179–186), the first paper on dinosaurs. The name dinosaur was coined by anatomist Richard Owen.

- 1826. The Zoological Gardens in Regent's Park is founded by the Zoological Society of London with help from Sir Thomas Raffles. It opened its "zoo" to the public for two days a week beginning April 27, 1828,
with the first hippopotamus to be seen in Europe since the ancient Romans showed one at the Coliseum. The Society will help save bird and animal species from extinction.


- 1827. Karl Ernst von Baer (Russian embryologist, 1792–1876) was the founder of comparative embryology. He demonstrated the existence of the mammalian ovum, and he proposed the germ-layer theory. His major works include *De ovi mammalium et hominis genesi* (1827) and *Über Entwickelungsgeschichte der Tiere* (1828; 1837).

- 1829. James Smithson (English, 1765–1829) donated seed money in his will for the founding of the Smithsonian Institution in Washington.

- 1830–1833. Sir Charles Lyell (English, 1797–1875) wrote *Principles of Geology* and gave the time needed for evolution to work. Darwin took this book to sea on the Beagle. Past environments were probably much more perturbed than Lyell admitted.

- 1830. Étienne Geoffroy Saint-Hilaire (French, 1772–1844) wrote *Principes de philosophie zoologique* (1830).

- 1831–1836. Charles Darwin (English, 1809–1882) and Captain Robert FitzRoy (English) went to sea as the original odd couple. Darwin's report is generally known as *The Voyage of the Beagle*.

- 1832. Thomas Nuttall (American?, 1786–1859) wrote *A Manual of the Ornithology of the United States and Canada* (1832) that was to become the standard text on the subject for most of the 19th century.

- 1835. William Swainson (English, 1789–1855) wrote *A Treatise on the Geography and Classification of Animals* (1835) in which he used ad hoc land bridges to explain animal distributions. He included some interesting, second-hand observations on Old World army ants.

- 1836. William Buckland (English, 1784–1856) wrote *Geology and Mineralogy Considered with Reference to natural Theology* (1836) in which he stated that there were several creations.

- 1839. Theodor Schwann (German, 1810–1882) wrote *Mikroskopischen Untersuchungen über die Übereinstimmungen in der Struktur und dem Wachstum der Thiere und Pflanzen* (1839). With him the cell theory was made general.

- 1839. Louis Agassiz (Swiss-American, 1807–1873) arrived in the U.S. A former student of Cuvier, Louis Agassiz was an expert on fossil fishes. He founded the Museum of Comparative Zoology, at Harvard University, and became Darwin's North American opposition. He was a popularizer of natural history and exhorted students to "study nature, not books". His *Nomenclator Zoologicus* (1842–1847) was a pioneering effort.
1840. Jan Evangelista Purkyně, a Czech physiologist, at Wroclaw proposes that the word "protoplasm" be applied to the formative material of young animal embryos.

1842. Baron Justus von Liebig wrote *Die Thierchemie* in which he applied classic methodology to studying animal tissues, suggested that animal heat is produced by combustion, and founded the science of biochemistry.

1843. John James Audubon, age 58, ascended the Missouri River to Fort Union at the mouth of the Yellowstone to sketch wild animals.

1844. Robert Chambers (Scottish, 1802–1871) wrote the *Vestiges of the Natural History of Creation* (1844) in which he included early evolutionary considerations. The most primitive species originated by spontaneous generation, but these gave rise to more advanced ones. This book, anonymously published, had a profound effect on Wallace. Evolution "was the manner in which the Divine Author has been pleased to work".

1845. von Siebold recognized Protozoa as single-celled animals.

1848. Josiah C. Nott (American), a physician from New Orleans, published his belief that mosquitoes transmitted malaria.

1848. Alfred Russel Wallace (British, 1823–1913) and Henry W. Bates (English, 1825–1892) arrived in the Amazon River valley in 1848. Bates stayed until 1859, exploring the upper Amazon. Wallace remained in the Amazon until 1852, exploring the Rio Negro. Wallace wrote *A Narrative of Travels on the Amazon and Rio Negro* (1853), and Bates wrote *The Naturalist on the River Amazons* (1863). Later (1854–1862), Wallace went to the Far East, reported in his *The Malay Archipelago* (1869).

1849. Arnold Adolph Berthold demonstrated by castration and testicular transplant that the testis produces a blood-borne substance promoting male secondary sexual characteristics.

1850? Thomas Hardwicke (British naturalist) discovered the lesser panda (*Ailurus fulgens*) in northern India.

1855. Alfred Russel Wallace (English, 1823–1913) wrote *On the law which has regulated the introduction of new species* (Ann. Mag. Nat. Hist., September 1855) with evolutionary ideas that drew upon Wallace's experiences in the Amazon.

1857. Discovery of Neanderthal skull-cap.


1864. Louis Pasteur disproved the spontaneous generation of cellular life.
1865. Gregor Mendel demonstrated in pea plants that inheritance follows definite rules. The Principle of Segregation states that each organism has two genes per trait, which segregate when the organism makes eggs or sperm. The Principle of Independent Assortment states that each gene in a pair is distributed independently during the formation of eggs or sperm. Mendel's trailblazing foundation for the science of genetics went unnoticed, to his lasting disappointment.

1869. Friedrich Miescher discovered nucleic acids in the nuclei of cells.

1876. Oskar Hertwig and Hermann Fol independently described (in sea urchin eggs) the entry of sperm into the egg and the subsequent fusion of the egg and sperm nuclei to form a single new nucleus.

1892. Hans Driesch separated the individual cells of a 2-cell sea urchin embryo and shows that each cell develops into a complete individual, thus disproving the theory of preformation and showing that each cell is "totipotent," containing all the hereditary information necessary to form an individual.

20th century

1900–1949

1900. Three biologists Hugo de Vries, Carl Correns, Erich von Tschermak independently rediscovered Mendel's paper on heredity.

1905. William Bateson coined the term "genetics" to describe the study of biological inheritance.

1907. Ivan Pavlov demonstrated conditioned responses with salivating dogs.

1922. Aleksandr Oparin proposed that the Earth's early atmosphere contained methane, ammonia, hydrogen, and water vapour, and that these were the raw materials for the origin of life.

1935. Konrad Lorenz described the imprinting behavior of young birds.

1937. In *Genetics and the Origin of Species*, Theodosius Dobzhansky applies the chromosome theory and population genetics to natural populations in the first mature work of neo-Darwinism, also called the modern synthesis, a term coined by Julian Huxley.

1938. A living coelacanth was found off the coast of southern Africa.

1940. Donald Griffin and Robert Galambos announced their discovery of echolocation by bats.

1950–1999

1952. American developmental biologists Robert Briggs and Thomas King cloned the first vertebrate by transplanting nuclei from leopard frog embryos into enucleated eggs. More differentiated cells were the less able they are to direct development in the enucleated egg.
• 1961. Joan Oró found that concentrated solutions of ammonium cyanide in water can produce the nucleotide adenine, a discovery that opened the way for theories on the origin of life.

• 1967. John Gurdon used nuclear transplantation to clone an African clawed frog; first cloning of a vertebrate using a nucleus from a fully differentiated adult cell.

• 1972. Stephen Jay Gould and Niles Eldredge proposed an idea called "punctuated equilibrium", which states that the fossil record is an accurate depiction of the pace of evolution, with long periods of "stasis" (little change) punctuated by brief periods of rapid change and species formation (within a lineage).

• 1996. Dolly the sheep was first clone of an adult mammal.

Timeline of solar astronomy

9th century

• 850 — Ahmad ibn Muhammad ibn Kathīr al-Farğānī (Alfraganus) gives values for the obliquity of the ecliptic, the precessional movement of the apogees of the Sun

10th century

• 900–929 — Muhammad ibn Jābir al-Harrānī al-Batānī (Albatenius) discovers that the direction of the Sun's eccentricity is changing

• 950–1000 — Ibn Yunus observes more than 10,000 entries for the Sun's position for many years using a large astrolabe with a diameter of nearly 1.4 metres

11th century

• 1031 — Abū al-Rayhān al-Bīrūnī calculates the distance between the Earth and the Sun in his Canon Mas'udicus

17th century

• 1613 — Galileo Galilei uses sunspot observations to demonstrate the rotation of the Sun

• 1619 — Johannes Kepler postulates a solar wind to explain the direction of comet tails
19th century

- 1802 — William Hyde Wollaston observes dark lines in the solar spectrum
- 1814 — Joseph Fraunhofer systematically studies the dark lines in the solar spectrum
- 1834 — Hermann Helmholtz proposes gravitational contraction as the energy source for the Sun
- 1843 — Heinrich Schwabe announces his discovery of the sunspot cycle and estimates its period to be about a decade
- 1852 — Edward Sabine shows that sunspot number is correlated with geomagnetic field variations
- 1859 — Richard Carrington discovers solar flares
- 1860 — Gustav Kirchhoff and Robert Bunsen discover that each chemical element has its own distinct set of spectral lines
- 1861 — Gustav Spörer discovers the variation of sun-spot latitudes during a solar cycle, explained by Spörer's law
- 1863 — Richard Carrington discovers the differential nature of solar rotation
- 1868 — Pierre Janssen and Norman Lockyer discover an unidentified yellow line in solar prominence spectra and suggest it comes from a new element which they name "helium"
- 1893 — Edward Maunder discovers the 1645-1715 Maunder sunspot minimum

20th century

- 1904 — Edward Maunder plots the first sunspot "butterfly diagram"
- 1906 — Karl Schwarzschild explains solar limb darkening
- 1908 — George Hale discovers the Zeeman splitting of spectral lines from sunspots
- 1925 — Cecilia Payne proposes hydrogen is the dominant element of the Sun, not iron
- 1929 — Bernard Lyot invents the coronagraph and observes the corona with an "artificial eclipse"
- 1942 — J.S. Hey detects solar radio waves
- 1949 — Herbert Friedman detects solar X-rays
- 1960 — Robert B. Leighton, Robert Noyes, and George Simon discover solar five-minute oscillations by observing the Doppler shifts of solar dark lines
- 1961 — Horace W. Babcock proposes the magnetic coiling sunspot theory
- 1970 — Roger Ulrich, John Leibacher, and Robert F. Stein deduce from theoretical solar models that the interior of the Sun could act as a resonant acoustic cavity
1975 — Franz-Ludwig Deubner makes the first accurate measurements of the period and horizontal wavelength of the five-minute solar oscillations

1981 — NASA retrieves data from 1978 that shows a comet crashing into the Sun

21st century

2004 — largest solar flare ever recorded occurs

Timeline of telescopes, observatories, and observing technology

Before the Common Era (BCE)

3500s BCE

- The earliest sundials known from the archaeological record are the obelisks from ancient Egyptian astronomy and Babylonian astronomy

1900s BCE

- Taosi Astronomical Observatory, Xiangfen County, Linfen City, Shanxi Province, China

1500s BCE

- Shadow clocks invented in ancient Egypt and Mesopotamia

600s BCE

- 11th–7th century BCE, Zhou dynasty astronomical observatory (寀台) in today's Xian, China

200s BCE

- Thirteen Towers solar observatory, Chankillo, Peru
100s BCE

- 220-206 BCE, Han dynasty astronomical observatory (灵台) in Chang'an and Luoyang. During East Han dynasty, astronomical observatory (灵台) built in Yanshi, Henan Province, China
- 220-150 BCE, Astrolabe invented by Apollonius of Perga

Common Era (CE)

400s

- 5th century – Observatory at Ujjain, India
- 5th century – Surya Siddhanta written in India
- 499 – Aryabhatiya written by Aryabhata

500s

- 6th century – Various siddhantas compiled by Indian astronomers

600s

- c. 628 – Brahmaşphutasiddhanta by Brahmagupta
- 632–647 – Cheomseongdae observatory is built in the reign of Queen Seondeok at Gyeongju, then the capital of Silla (present day South Korea)
- 618–1279 – Tang dynasty-Song dynasty, observatories built in Chang'an, Kaifeng, Hangzhou, China

700s

- 700–77 – The first Zij treatise, Az-Zīj ʿalā Sinī al-ʿArab, written by Ibrahim al-Fazari and Muhammad al-Fazari
- 700–96 – Brass astrolabe constructed by Muhammad al-Fazari based on Hellenistic sources
- c. 777 – Yaqūb ibn Tāriq wrote Az-Zij al-Mahlul min as-Sindhind li-Darajat Daraja based on Brahmagupta and Surya Siddhanta
800s

- 9th century – quadrant invented by Muhammad ibn Mūsā al-Khwārizmī in 9th century Baghdad and is used for astronomical calculations
- 800–33 – The first modern observatory research institute built in Baghdad, Iraq, by Arabic astronomers during time of Al-Mamun
- 800–50 – Zij al-Sindhind written by Muhammad ibn Mūsā al-Khwārizmī (Algorismi)
- 825–35 – Al-Shammisiyyah observatory by Habash al-Hasib al-Marwazi in Baghdad, Iraq
- 869 – Mahodayapuram Observatory in Kerala, India, by Sankaranarayana

900s

- 10th century – Large astrolabe of diameter 1.4 meters constructed by Ibn Yunus
- 994 – First sextant constructed in Ray, Iran, by Abu-Mahmud al-Khujandi. It was a very large mural sextant that achieved a high level of accuracy for astronomical measurements.

1000s

- 1000 – Mokattam observatory in Egypt for Al-Hakim bi-Amr Allah
- 1000 – Volvelle, an early paper analog computer, invented by Arabic physicians and improved by Abu Rayhan Biruni for use in astronomy.
- 11th century – Planisphere invented by Biruni
- 11th century – Universal latitude-independent astrolabe invented by Abū Ishāq Ibrāhīm al-Zarqālī (Arzachel)
- 1015 – Equatorium invented by Arzachel in Al-Andalus
- 1023 – Hamedan observatory in Persia
- c. 1030 – Treasury of Optics by Ibn al-Haytham (Alhazen) of Iraq and Egypt
- 1074–92 – Malikshah Observatory at Isfahan used by Omar Khayyām
- 1086 – Northern Song dynasty astronomical observatory

1100s

- 1100–50 – Jabir ibn Aflah (Geber) (c. 1100–1150) invented the torquetum, an observational instrument and mechanical analog computer device
Tables of Toledo based on Arzachel and published by Gerard of Cremona

Sinjaric Tables written by al-Khazini

Cairo al-Bataihi observatory for Al-Afdal Shahanshah
cs. 1020 – Geared mechanical astrolabe invented by Ibn Samh

1206 – Al-Jazari invented his largest astronomical clock, the "castle clock", which is considered to be the first programmable analog computer.

1252–72 – Alfonso's Tables recorded

1259 – Maragheh observatory and library of Nasir al-Din al-Tusi built in Persia under Hulagu Khan
c. 1270 – Terrace for Managing Heaven 26 observatory network of Guo Shoujing under Khubilai Khan

1272 – Zij-i Ilkhani written by Nasir al-Din al-Tusi

1276 – Dengfeng Star Observatory Platform, Gaocheng, Dengfeng City, Henan Province, China

1371 – The idea of using hours of equal time length throughout the year in a sundial was the innovation of Ibn al-Shatir

1400–29 – Khaqani Zij by Jamshīd al-Kāshī

1417 – Speculum Planetarum by Simones de Selandia

1420 – Samarkand observatory of Ulugh Beg

1437 – Zij-i-Sultani written by Ulugh Beg

1442 – Beijing Ancient Observatory in China

1467–71 – Observatory at Oradea, Hungary for Matthias Corvinus

1472 – The Nuremberg observatory of Regiomontanus and Bernhard Walther.

1540 Apian "Astronomicum Caesareum"

1560 – Kassel observatory under Landgrave Wilhelm IV of Hesse
1574 – Taqi al-Din Muhammad ibn Ma'ruz describes a long-distance magnifying device in his *Book of the Light of the Pupil of Vision and the Light of the Truth of the Sights*, which may have possibly been an early rudimentary telescope.

1575–80 – Constantinople Observatory of Taqi ad-Din under Sultan Murad III

1576 – Royal Danish Astronomical Observatory Uraniborg at Hven by Tycho Brahe

1577 – Constantinople observatory constructed for Taqi al-Din Muhammad ibn Ma'ruz

1577–80 – *Unbored Pearl*, a Zij treatise by Taqi al-Din

1577–80 – Taqi al-Din invents a mechanical astronomical clock that measures time in seconds, one of the most important innovations in 16th-century practical astronomy, as previous clocks were not accurate enough to be used for astronomical purposes.

1577–80 – Taqi al-Din invents framed sextant

1581 – Royal Danish Astronomical Observatory Stjerneborg at Hven by Tycho Brahe

1589–90 – Celestial globe without seams invented in Mughal India by Ali Kashmari ibn Luqman during Akbar the Great's reign.

1600s

1600 – Prague observatory in Benátky nad Jizerou by Tycho Brahe

1603 – Johann Bayer's *Uranometria* is published

1608 – Hans Lippershey tries to patent an optical refracting telescope, the first recorded functional telescope

1609 – Galileo Galilei builds his first optical refracting telescope

1616 – Niccolò Zucchi experiments with a reflecting telescope

1633 – Construction of Leiden University Observatory

1641 – William Gascoigne invents telescope cross hairs

1641 – Danzig/Gdansk observatory of Jan Hevelius

1642 – Copenhagen University Royal observatory

1661 – James Gregory proposes an optical reflecting telescope with parabolic mirrors

1667 – Paris Observatory

1668 – Isaac Newton constructs the first "practical" reflecting telescope, the Newtonian telescope

1672 – Laurent Cassegrain designs the Cassegrain telescope

1675 – Royal Greenwich Observatory of England
• 1684 – Christiaan Huygens publishes "Astroscopia Compendiaria" in which he described the design of very long aerial telescopes

1700s

• 1704 – First observatory at Cambridge University (based at Trinity College)
• 1724 – Indian observatory of Sawai Jai Singh at Delhi
• 1725 – St. Petersburg observatory at Royal Academy
• 1732 – Indian observatories of Sawai Jai Singh at Varanasi, Ujjain, Mathura, Madras
• 1733 – Chester Moore Hall invents the achromatic lens refracting telescope
• 1734 – Indian observatory of Sawai Jai Singh at Jaipur
• 1753 – Real Observatorio de Cádiz (Spain)
• 1753 – Vilnius Observatory at Vilnius University, Lithuania
• 1758 – John Dollond reinvents the achromatic lens
• 1761 – Joseph-Nicolas Delisle 62 observing station network for observing the transit of Venus
• 1769 – Short reflectors used at 63 station network for transit of Venus
• 1774 – Vatican Observatory (Specola Vaticana), originally established as the Observatory of the Roman College.
• 1780 – Florence Specola observatory
• 1789 – William Herschel finishes a 49-inch (1.2 m) optical reflecting telescope, located in Slough, England
• 1798 – Real Observatorio de la Isla de Léon (actualmente Real Instituto y Observatorio de la Armada) (Spain)

1800s

• 1803 National Astronomical Observatory (Colombia), the first observatory in the Americas
• 1836 Swathithirunal opened Trivandrum observatory
• 1839 Louis Jacques Mandé Daguerre (inventor of the daguerreotype photographic process) attempts in to photograph the moon. Tracking errors in guiding the telescope during the long exposure made the photograph came out as an indistinct fuzzy spot
• 1840 – John William Draper takes make a successful photographic image of the Moon, the first astronomical photograph
• 1845 – Lord Rosse finishes the Birr Castle 72-inch (1.8 m) optical reflecting telescope, located in Parsonstown, Ireland
1849 – Santiago observatory set up by USA, later becomes Chilean National Observatory (now part of the University of Chile)

1859 – Kirchhoff and Bunsen develop spectroscopy

1864 – Herschel’s so-called GC (General Catalogue) of nebulae and star clusters published

1868 – Janssen and Lockyer discover Helium observing spectra of Sun

1871 – German Astronomical Association organized network of 13 (later 16) observatories for stellar proper motion studies

1863 – William Allen Miller and Sir William Huggins use the photographic wet collodion plate process to obtain the first ever photographic spectrogram of a star, Sirius and Capella.

1872 – Henry Draper photographs a spectrum of Vega that shows absorption lines.

1878 – Dreyer published a supplement to the GC of about 1000 new objects, the New General Catalogue

1883 – Andrew Ainslie Common uses the photographic dry plate process and a 36-inch (91 cm) reflecting telescope in his backyard to record 60 minute exposures of the Orion nebula that for the first time showed stars too faint to be seen by the human eye.

1887 – Paris conference institutes Carte du Ciel project to map entire sky to 14th magnitude photographically

1888 – First light of 91cm refracting telescope at Lick Observatory, on Mount Hamilton near San Jose, California

1889 – Astronomical Society of the Pacific founded

1890 – Albert A. Michelson proposes the stellar interferometer

1892 – George Ellery Hale finishes a spectroheliograph, which allows the Sun to be photographed in the light of one element only

1897 – Alvan Clark finishes the Yerkes 40-inch (1.0 m) optical refracting telescope, located in Williams Bay, Wisconsin

1900s

1902 – Dominion Observatory, Ottawa, Ontario, Canada established

1904 – Observatories of the Carnegie Institution of Washington founded

1907 – F.C. Brown and Joel Stebbins develop a selenium cell photometer at the University of Illinois Observatory.

1910s
• 1912 – Joel Stebbins and Jakob Kunz begin to use a photometer using a photoelectric cell at the University of Illinois Observatory.
• 1917 – Mount Wilson 100-inch (2.5 m) optical reflecting telescope begins operation, located in Mount Wilson, California
• 1918 – 1.8m Plaskett Telescope begins operation at the Dominion Astrophysical Observatory, Victoria, British Columbia, Canada
• 1919 – International Astronomical Union (IAU) founded

1930s
• 1930 – Bernard-Ferdinand Lyot invents the coronagraph
• 1930 – Karl Jansky builds a 30-meter long rotating aerial radio telescope. This was the first radio telescope.
• 1933 – Bernard-Ferdinand Lyot invents the Lyot filter
• 1934 – Bernhard Schmidt finishes the first 14-inch (360 mm) Schmidt optical reflecting telescope
• 1936 – Palomar 18-inch (460 mm) Schmidt optical reflecting telescope begins operation, located in Palomar, California
• 1937 – Grote Reber builds a 31-foot (9.4 m) radio telescope

1940s
• 1941 – Dmitri Dmitrievich Maksutov invents the Maksutov telescope which is adopted by major observatories in the Soviet Union and internationally. It is now also a popular design with amateur astronomers
• 1946 – Martin Ryle and his group perform the first astronomical observations with a radio interferometer
• 1947 – Bernard Lovell and his group complete the Jodrell Bank 218-foot (66 m) non-steerable radio telescope
• 1949 – Palomar 48-inch (1.2 m) Schmidt optical reflecting telescope begins operation, located in Palomar, California
• 1949 – Palomar 200-inch (5.1 m) optical reflecting telescope (Hale telescope) begins regular operation, located in Palomar, California

1950s
• 1953 – Luoxue Mountain Cosmic Rays Research Center, Yunnan Province, in China founded
• 1954 – Earth rotation aperture synthesis suggested (see e.g. Christiansen and Warburton (1955))
• 1956 – Dwingeloo Radio Observatory 25 m telescope completed, Dwingeloo, Netherlands
• 1957 – Bernard Lovell and his group complete the Jodrell Bank 250-foot (75 m) steerable radio telescope (the Lovell Telescope)
• 1957 – Peter Scheuer publishes his P(D) method for obtaining source counts of spatially unresolved sources
• 1959 – Radio Observatory of the University of Chile, located at Maipú, Chile founded
• 1959 – The 3C catalogue of radio sources is published (revised in 1962)
• 1959 – The Shane 120-inch (3.0 m) Telescope Opened at Lick Observatory

1960s

• 1960 – Owens Valley 27-meter radio telescopes begin operation, located in Big Pine, California
• 1961 – Parkes 64-metre radio telescope begins operation, located near Parkes, Australia
• 1962 – European Southern Observatory (ESO) founded
• 1962 – Kitt Peak solar observatory founded
• 1962 – Green Bank, West Virginia 90m radio telescope
• 1962 – Orbiting Solar Observatory 1 satellite launched
• 1963 – Arecibo 300-meter radio telescope begins operation, located in Arecibo, Puerto Rico
• 1964 – Martin Ryle’s 1-mile (1.6 km) radio interferometer begins operation, located in Cambridge, England
• 1965 – Owens Valley 40-meter radio telescope begins operation, located in Big Pine, California
• 1967 – First VLBI images, with 183 km baseline
• 1969 – Observations start at Big Bear Solar Observatory, located in Big Bear, California
• 1969 – Las Campanas Observatory

1970s

• 1970 – Cerro Tololo 158-inch (4.0 m) optical reflecting telescope begins operation, located in Cerro Tololo, Chile
• 1970 – Kitt Peak National Observatory 158-inch (4.0 m) optical reflecting telescope begins operation, located near Tucson, Arizona
• 1970 – Uhuru x-ray telescope satellite
• 1970 – Antoine Labeyrie performs the first high-resolution optical speckle interferometry observations
• 1970 – Westerbork Synthesis Radio Telescope completed, near Westerbork, Netherlands
• 1972 – 100 m Effelsberg radio telescope inaugurated (Germany)
• 1973 – UK Schmidt Telescope 1.2 metre optical reflecting telescope begins operation, located in Anglo-Australian Observatory near Coonabarabran, Australia

• 1974 – Anglo-Australian Telescope 153-inch (3.9 m) optical reflecting telescope begins operation, located in Anglo-Australian Observatory near Coonabarabran, Australia

• 1975 – Gerald Smith, Frederick Landauer, and James Janesick use a CCD to observe Uranus, the first astronomical CCD observation

• 1975 – Antoine Labeyrie builds the first two-telescope optical interferometer

• 1976 – The 6-m BTA-6 (Bolshoi Teleskop Azimuthalnyi or “Large Altazimuth Telescope”) goes into operation on Mt. Pashtukhov in the Russian Caucasus

• 1978 – Multiple Mirror 176-inch (4.5 m) equivalent optical/infrared reflecting telescope begins operation, located in Amado, Arizona

• 1978 – International Ultraviolet Explorer (IUE) telescope satellite

• 1978 – Einstein High Energy Astronomy Observatory x-ray telescope satellite

• 1979 – UKIRT 150-inch (3.8 m) infrared reflecting telescope begins operation, located at Mauna Kea Observatory, Hawaii

• 1979 – Canada-France-Hawaii 140-inch (3.6 m) optical reflecting telescope begins operation, located at Mauna Kea Observatory, Hawaii

• 1979 – NASA Infrared Telescope Facility 120-inch (3.0 m) infrared reflecting telescope begins operation, located at Mauna Kea, Hawaii

1980s

• 1980 – Completion of construction of the VLA, located in Socorro, New Mexico

• 1983 – Infrared Astronomical Satellite (IRAS) telescope

• 1984 – IRAM 30-m telescope at Pico Veleta near Granada, Spain completed

• 1987 – 15-m James Clerk Maxwell Telescope UK submillimetre telescope installed at Mauna Kea Observatory

• 1987 – 5-m Swedish-ESO Submillimetre Telescope (SEST) installed at the ESO La Silla Observatory

• 1988 – Australia Telescope Compact Array aperture synthesis radio telescope begins operation, located near Narrabri, Australia

• 1989 – Cosmic Background Explorer (COBE) satellite

1990s
• 1990 – Hubble 2.4m space Telescope launched, mirror found to be flawed
• 1991 – Compton Gamma Ray Observatory satellite
• 1993 – Keck 10-meter optical/infrared reflecting telescope begins operation, located at Mauna Kea, Hawaii
• 1993 – Very Long Baseline Array of 10 dishes
• 1995 – Cambridge Optical Aperture Synthesis Telescope (COAST)—the first very high resolution optical astronomical images (from aperture synthesis observations)
• 1995 – Giant Metrewave Radio Telescope of thirty 45 m dishes at Pune
• 1996 – Keck 2 10-meter optical/infrared reflecting telescope begins operation, located at Mauna Kea, Hawaii
• 1997 – The Japanese HALCA satellite begins operations, producing first VLBI observations from space, 25,000 km maximum baseline
• 1998 – First light at VLT1, the 8.2 m ESO telescope

2000s

• 2001 – First light at the Keck Interferometer. Single-baseline operations begin in the near-infrared.
• 2001 – First light at VLTI interferometry array. Operations on the interferometer start with single-baseline near-infrared observations with the 103 m baseline.
• 2005 – First imaging with the VLTI using the AMBER optical aperture synthesis instrument and three VLT telescopes.
• 2005 – First light at SALT, the largest optical telescope in the Southern Hemisphere, with a primary mirror diameter of 11 meters.

Timeline of human evolution

Unicellular life

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.1 Ga (billion years ago)</td>
<td>The earliest life appears.</td>
</tr>
<tr>
<td></td>
<td>Further information: Abiogenesis</td>
</tr>
<tr>
<td>3.9 Ga</td>
<td>Cells resembling prokaryotes appear.</td>
</tr>
</tbody>
</table>
Further information: Cell (biology) § Origins

3.5 Ga
This marks the first appearance of oxygenic photosynthesis and therefore the first occurrence of large quantities of atmospheric oxygen on Earth.

Further information: Evolution of photosynthesis § Origin, and Great Oxygenation Event

2.5 Ga
First organisms to use oxygen. By 2400 Ma, in what is referred to as the Great Oxygenation Event, the pre-oxygen anaerobic forms of life were wiped out by the oxygen producers.

Further information: Geological history of oxygen

2.1 Ga
More complex cells appear: the eukaryotes.

Further information: Eukaryote § Origin of eukaryotes

1.2 Ga
Sexual reproduction evolves, leading to faster evolution where genes are mixed in every generation enabling greater variation for subsequent selection.

0.9 Ga
The choanoflagellates may look similar to the ancestors of the entire animal kingdom, and in particular they may be the direct ancestors of sponges.

Proterospongia (members of the Choanoflagellata) are the best living examples of what the ancestor of all animals may have looked like. They live in colonies, and show a primitive level of cellular specialization for different tasks.

Animals or Animalia

<table>
<thead>
<tr>
<th>Date</th>
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<tbody>
<tr>
<td>700–660 Ma</td>
<td>Urmetazoan: The first fossils that might represent animals appear in the 665-million-year-old rocks of the Trezona Formation of South Australia. These fossils are interpreted as being early sponges. Separation from the Porifera (sponges) lineage. Eumetazoon/Diploblast: separation from the Ctenophora (&quot;comb jellies&quot;) lineage. Planulozoa/ParaHoxozoa: separation from the Placozoa and Cnidaria lineages. Almost all cnidarians possess nerves and muscles. Because they are the simplest animals to possess them, their direct ancestors were very probably the first animals to use nerves and muscles together. Cnidarians are also the</td>
</tr>
</tbody>
</table>
first animals with an actual body of definite form and shape. They have radial symmetry. The first eyes evolved at this time.

| 570–550 Ma | Urbilaterian: Bilateria/Triploblasts, Nephrozoa (555 Ma), last common ancestor of protostomes (including the arthropod [insect, crustacean] and platyzoan [flatworms] lineages) and the deuterostomes (including the vertebrate [human] lineage). Earliest development of the brain, and of bilateral symmetry. Archaic representatives of this stage are flatworms, the simplest animals with organs that form from three germ layers. |

| 541 Ma | Most known animal phyla appeared in the fossil record as marine species during the Cambrian explosion. Deuterostomes, last common ancestor of the chordate [human] lineage, the Echinodermata (starfish, sea urchins, sea cucumbers, etc.) and Hemichordata (acorn worms and graptolites).

An archaic survivor from this stage is the acorn worm, sporting a circulatory system with a heart that also functions as a kidney. Acorn worms have a gill-like structure used for breathing, a structure similar to that of primitive fish. Acorn worms have a plexus concentrated into both dorsal and ventral nerve cords. The dorsal cord reaches into the proboscis, and is partially separated from the epidermis in that region. This part of the dorsal nerve cord is often hollow, and may well be homologous with the brain of vertebrates. |

**Chordates**

<table>
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<th>Date</th>
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</table>
| 530 Ma | *Pikaia* is an iconic ancestor of modern chordates and vertebrates. Other, earlier chordate predecessors include *Myllokunmingia fengjiaoa, Haikouella lanceolata,* and *Haikouichthys ercaicunensis.*

The lancelet, still living today, retains some characteristics of the primitive chordates. It resembles *Pikaia.*

Conodonts are a famous type of early (495 Mya and later) chordate fossil; they have the peculiar teeth of an eel-shaped animal characterized by large eyes, fins with fin rays, chevron-shaped muscles and a notochord. The animal is sometimes called a conodont, and sometimes a conodontophore (conodont-bearer) to avoid confusion. |
The first vertebrates appear: the ostracoderms, jawless fish related to present-day lampreys and hagfishes. *Haikouichthys* and *Myllokunmingia* are examples of these jawless fish, or Agnatha. (See also prehistoric fish). They were jawless and their internal skeletons were cartilaginous. They lacked the paired (pectoral and pelvic) fins of more advanced fish. They were precursors to the Osteichthyes (bony fish).

| 480 Ma | The Placoderms were prehistoric fishes. Placoderms were some of the first jawed fishes (Gnathostomata), their jaws evolving from the first gill arch. |

| 410 Ma | The first coelacanth appears; this order of animals was thought to be extinct until living specimens were discovered in 1938. It is often referred to as a living fossil. |

### Tetrapods

<table>
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<tr>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>390 Ma</td>
<td>Some fresh water lobe-finned fish (Sarcopterygii) develop legs and give rise to the Tetrapoda. The first tetrapods evolved in shallow and swampy freshwater habitats. Primitive tetrapods developed from a lobe-finned fish (an &quot;osteolepid Sarcopterygian&quot;), with a two-lobed brain in a flattened skull, a wide mouth and a short snout, whose upward-facing eyes show that it was a bottom-dweller, and which had already developed adaptations of fins with fleshy bases and bones. (The &quot;living fossil&quot; coelacanth is a related lobe-finned fish without these shallow-water adaptations.) Tetrapod fishes used their fins as paddles in shallow-water habitats choked with plants and detritus. The universal tetrapod characteristics of front limbs that bend backward at the elbow and hind limbs that bend forward at the knee can plausibly be traced to early tetrapods living in shallow water. <em>Panderichthys</em> is a 90–130 cm (35–50 in) long fish from the Late Devonian period (380 Mya). It has a large tetrapod-like head. <em>Panderichthys</em> exhibits features transitional between lobe-finned fishes and early tetrapods. Trackway impressions made by something that resembles <em>Ichthyostega</em>'s limbs were formed 390 Ma in Polish marine tidal sediments. This suggests tetrapod evolution is older than the dated fossils of <em>Panderichthys</em> through to <em>Ichthyostega</em>.</td>
</tr>
</tbody>
</table>

250
Lungfishes retain some characteristics of the early Tetrapoda. One example is the Queensland lungfish.

375 Ma

*Tiktaalik* is a genus of sarcopterygian (lobe-finned) fishes from the late Devonian with many tetrapod-like features. It shows a clear link between *Panderichthys* and *Acanthostega*.

365 Ma

*Acanthostega* is an extinct amphibian, among the first animals to have recognizable limbs. It is a candidate for being one of the first vertebrates to be capable of coming onto land. It lacked wrists, and was generally poorly adapted for life on land. The limbs could not support the animal’s weight. *Acanthostega* had both lungs and gills, also indicating it was a link between lobe-finned fish and terrestrial vertebrates.

*Ichthyostega* is an early tetrapod. Being one of the first animals with legs, arms, and finger bones, *Ichthyostega* is seen as a hybrid between a fish and an amphibian. *Ichthyostega* had legs but its limbs probably were not used for walking. They may have spent very brief periods out of water and would have used their legs to paw their way through the mud.

Amphibia were the first four-legged animals to develop lungs which may have evolved from *Hynerpeton* 360 Ma.

Amphibians living today still retain many characteristics of the early tetrapods.

300 Ma

From amphibians came the first reptiles: *Hylonomus* is the earliest known reptile. It was 20 cm (8 in) long (including the tail) and probably would have looked rather similar to modern lizards. It had small sharp teeth and probably ate millipedes and early insects. It is a precursor of later Amniotes and mammal-like reptiles. Alpha keratin first evolves here. It is used in the claws of modern lizards and birds, and hair in mammals.

Evolution of the amniotic egg gives rise to the Amniota, reptiles that can reproduce on land and lay eggs on dry land. They did not need to return to water for reproduction. This adaptation gave them the capability to colonize the uplands for the first time.

Reptiles have advanced nervous systems, compared to amphibians, with twelve pairs of cranial nerves.

**Mammals**
<table>
<thead>
<tr>
<th>Date</th>
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<tbody>
<tr>
<td>256 Ma</td>
<td>Shortly after the appearance of the first reptiles, two branches split off. One branch is the Sauropsids, from which come the modern reptiles and birds. The other branch is Synapsida (Synapsids), from which come modern mammals. Both had temporal fenestrae, a pair of holes in their skulls behind the eyes, which were used to increase the space for jaw muscles. Synapsids had one opening on each side, while diapsids (a branch of Sauropsida) had two. The earliest <strong>mammal-like reptiles</strong> are the pelycosaurs. The pelycosaurs were the first animals to have temporal fenestrae. Pelycosaurs are not therapsids but soon they gave rise to them. The Therapsida were the direct ancestor of mammals. The therapsids have temporal fenestrae larger and more mammal-like than pelycosaurs, their teeth show more serial differentiation, and later forms had evolved a secondary palate. A secondary palate enables the animal to eat and breathe at the same time and is a sign of a more active, perhaps warm-blooded, way of life.</td>
</tr>
<tr>
<td>220 Ma</td>
<td>One sub-group of therapsids, the cynodonts, evolved more mammal-like characteristics. The jaws of cynodonts resemble modern mammal jaws. This group of animals likely contains a species which is the direct ancestor of all modern mammals.</td>
</tr>
<tr>
<td>220 Ma</td>
<td>From Eucynodontia (cynodonts) came the first mammals. Most early mammals were small shrew-like animals that fed on insects. Although there is no evidence in the fossil record, it is likely that these animals had a constant body temperature and milk glands for their young. The neocortex region of the brain first evolved in mammals and thus is unique to them. Monotremes are an egg-laying group of mammals represented amongst modern animals by the platypus and echidna. Recent genome sequencing of the platypus indicates that its sex genes are closer to those of birds than to those of the therian (live birthing) mammals. Comparing this to other mammals, it can be inferred that the first mammals to gain sexual differentiation through the existence or lack of SRY gene (found in the y-Chromosome) evolved after the monotreme lineage split off.</td>
</tr>
<tr>
<td>160 Ma</td>
<td><em>Juramaia sinensis</em> is the earliest known eutherian mammal fossil.</td>
</tr>
<tr>
<td>100 Ma</td>
<td>Last common ancestor of mice and humans (base of the clade Euarchontoglires).</td>
</tr>
</tbody>
</table>
**Primates**

<table>
<thead>
<tr>
<th>Date</th>
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<tbody>
<tr>
<td>85–66 Ma</td>
<td>A group of small, nocturnal, arboreal, insect-eating mammals called Euarchonta begins a speciation that will lead to the orders of primates, treeshrews and flying lemurs. Primatomorpha is a subdivision of Euarchonta including primates and their ancestral stem-primates Plesiadapiformes. An early stem-primate, <em>Plesiadapis</em>, still had claws and eyes on the side of the head, making it faster on the ground than in the trees, but it began to spend long times on lower branches, feeding on fruits and leaves. The Plesiadapiformes very likely contain the ancestor species of all primates. They first appeared in the fossil record around 66 million years ago, soon after the Cretaceous–Paleogene extinction event that eliminated about three-quarters of plant and animal species on Earth, including most dinosaurs. One of the last Plesiadapiformes is <em>Carpolestes simpsoni</em>, having grasping digits but not forward-facing eyes.</td>
</tr>
<tr>
<td>63 Ma</td>
<td>Primates diverge into suborders Strepsirrhini (wet-nosed primates) and Haplorrhini (dry-nosed primates). Strepsirrhini contain most prosimians; modern examples include lemurs and lorises. The haplorrhines include the two living groups: prosimian tarsiers, and simian monkeys, including apes. One of the earliest haplorrhines is <em>Teilhardina asiatica</em>, a mouse-sized, diurnal creature with small eyes. The Haplorrhini metabolism lost the ability to produce vitamin C, forcing all descendants to include vitamin C-containing fruit in their diet.</td>
</tr>
<tr>
<td>30 Ma</td>
<td>Haplorrhini splits into infraorders Platyrhini and Catarrhini. Platyrhines, New World monkeys, have prehensile tails and males are color blind. The individuals whose descendants would become Platyrhini are conjectured to have migrated to South America either on a raft of vegetation or via a land bridge (the hypothesis now favored). Catarrhines mostly stayed in Africa as the two continents drifted apart. Possible early ancestors of catarrhines include <em>Aegyptopithecus</em> and <em>Saadanius</em>.</td>
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<tr>
<td>25 Ma</td>
<td>Catarrhini splits into 2 superfamilies, Old World monkeys (Cercopithecoidea) and apes (Hominidea). Our trichromatic color vision had its genetic origins in this period. <em>Proconsul</em> was an early genus of catarrhine primates. They had a mixture of Old World</td>
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</table>
monkey and ape characteristics. *Proconsul*’s monkey-like features include thin tooth enamel, a light build with a narrow chest and short forelimbs, and an arboreal quadrupedal lifestyle. Its ape-like features are its lack of a tail, ape-like elbows, and a slightly larger brain relative to body size.

*Proconsul africanus* is a possible ancestor of both great and lesser apes, including humans.

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<th>Date</th>
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<tr>
<td>18 Ma</td>
<td>Hominidae (great ape ancestors) speciate from the ancestors of the gibbon (lesser apes) between c. 20 to 16 Ma.</td>
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<td>16 Ma</td>
<td>Homininae ancestors speciate from the ancestors of the orangutan between c. 18 to 14 Ma. <em>Pierolapithecus catalaunicus</em> is thought to be a common ancestor of humans and the other great apes, or at least a species that brings us closer to a common ancestor than any previous fossil discovery. It had the special adaptations for tree climbing as do present-day humans and other great apes: a wide, flat rib cage, a stiff lower spine, flexible wrists, and shoulder blades that lie along its back.</td>
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<tr>
<td>12 Ma</td>
<td>Danuvius guggenmosi is the first-discovered Late Miocene great ape with preserved long bones, and greatly elucidates the anatomical structure and locomotion of contemporary apes. It had adaptations for both hanging in trees (suspensory behavior) and walking on two legs (bipedalism)—whereas, among present-day hominids, humans are better adapted for the latter and the others for the former. <em>Danuvius</em> thus had a method of locomotion unlike any previously known ape called &quot;extended limb clambering&quot;, walking directly along tree branches as well as using arms for suspending itself. The last common ancestor between humans and other apes possibly had a similar method of locomotion.</td>
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<tr>
<td>6 Ma</td>
<td>The clade currently represented by humans and the genus <em>Pan</em> (common chimpanzees and bonobos) splits from the ancestors of the gorillas between c. 10 to 8 Ma. Hominini: The latest common ancestor of humans and chimpanzees is estimated to have lived between roughly 10 to 5 million years ago. Both chimpanzees and humans have a larynx that repositions during the first two years of life to a spot between the pharynx and the lungs, indicating that the common ancestors have this feature, a precondition for vocalized speech in humans. Speciation may have begun shortly after 10 Ma, but late admixture between the lineages may have taken place until after 5 Ma. Candidates of Hominina or Homininae species which lived in this time period include <em>Ouranopithecus</em> (c. 8 Ma), <em>Graecopithecus</em> (c. 7 Ma), <em>Sahelanthropus tchadensis</em> (c. 7 Ma), <em>Orrorin tugenensis</em> (c. 6 Ma).</td>
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</table>
Ardipithecus is, or may be, a very early hominin genus (tribe Hominini and subtribe Hominina). Two species are described in the literature: *A. ramidus*, which lived about 4.4 million years ago during the early Pliocene, and *A. kadabba*, dated to approximately 5.6 million years ago (late Miocene). *A. ramidus* had a small brain, measuring between 300 and 350 cm³. This is about the same size as the modern bonobo and female common chimpanzee brain; it is somewhat smaller than the brain of australopithecines like Lucy (400 to 550 cm³) and slightly over a fifth the size of the modern *Homo sapiens* brain.

Ardipithecus was arboreal, meaning it lived largely in the forest where it competed with other forest animals for food, no doubt including the contemporary ancestor of the chimpanzees. Ardipithecus was probably bipedal as evidenced by its bowl shaped pelvis, the angle of its foramen magnum and its thinner wrist bones, though its feet were still adapted for grasping rather than walking for long distances.

### 3.6 Ma
A member of the *Australopithecus afarensis* left human-like footprints on volcanic ash in Laetoli, northern Tanzania, providing strong evidence of full-time bipedalism. *Australopithecus afarensis* lived between 3.9 and 2.9 million years ago, and is considered one of the earliest hominins—those species that developed and comprised the lineage of *Homo* and *Homo*'s closest relatives after the split from the line of the chimpanzees.

It is thought that *A. afarensis* was ancestral to both the genus *Australopithecus* and the genus *Homo*. Compared to the modern and extinct great apes, *A. afarensis* had reduced canines and molars, although they were still relatively larger than in modern humans. *A. afarensis* also has a relatively small brain size (380–430 cm³) and a prognathic (anterior-projecting) face.

Australopithecines have been found in savannah environments; they probably developed their diet to include scavenged meat. Analyses of *Australopithecus africanus* lower vertebrae suggests that these bones changed in females to support bipedalism even during pregnancy.

### 3.5–3.3 Ma
*Kenyanthropus platyops*, a possible ancestor of *Homo*, emerges from the *Australopithecus*. Stone tools are deliberately constructed.

### 3 Ma
The bipedal australopithecines (a genus of the subtribe Hominina) evolve in the savannas of Africa being hunted by *Megantereon*. Loss of body hair occurs from 3 to 2 Ma, in parallel with the development of full bipedalism.

Homo
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<td>2.5–2.0 Ma</td>
<td>Early <em>Homo</em> appears in East Africa, speciating from australopithecine ancestors. Sophisticated stone tools mark the beginning of the Lower Paleolithic. <em>Australopithecus garhi</em> was using stone tools at about 2.5 Ma. <em>Homo habilis</em> is the oldest species given the designation <em>Homo</em>, by Leakey et al. (1964). <em>H. habilis</em> is intermediate between <em>Australopithecus afarensis</em> and <em>H. erectus</em>, and there have been suggestions to reclassify it within genus <em>Australopithecus</em>, as <em>Australopithecus habilis</em>. Stone tools found at the Shangchen site in China and dated to 2.12 million years ago are considered the earliest known evidence of hominins outside Africa, surpassing Dmanisi in Georgia by 300,000 years. Further information: Homo naledi and Homo rudolfensis</td>
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<tr>
<td>1.9–0.5 Ma</td>
<td><em>Homo erectus</em> derives from early <em>Homo</em> or late <em>Australopithecus</em>. <em>Homo habilis</em>, although significantly different of anatomy and physiology, is thought to be the ancestor of <em>Homo ergaster</em>, or African <em>Homo erectus</em>; but it is also known to have coexisted with <em>H. erectus</em> for almost half a million years (until about 1.5 Ma). From its earliest appearance at about 1.9 Ma, <em>H. erectus</em> is distributed in East Africa and Southwest Asia (<em>Homo georgicus</em>). <em>H. erectus</em> is the first known species to develop control of fire, by about 1.5 Ma. <em>H. erectus</em> later migrates throughout Eurasia, reaching Southeast Asia by 0.7 Ma. It is described in a number of subspecies. Evolution of dark skin at about 1.2 Ma. <em>Homo antecessor</em> may be a common ancestor of humans and Neanderthals. At present estimate, humans have approximately 20,000–25,000 genes and share 99% of their DNA with the now extinct Neanderthal and 95–99% of their DNA with their closest living evolutionary relative, the chimpanzees. The human variant of the FOXP2 gene (linked to the control of speech) has been found to be identical in Neanderthals.</td>
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<td>0.8–0.3 Ma</td>
<td>Divergence of Neanderthal and Denisovan lineages from a common ancestor. <em>Homo heidelbergensis</em> (in Africa also known as <em>Homo rhodesiensis</em>) had long been thought to be a likely candidate for the last common ancestor of the Neanderthal and modern human lineages. However, genetic evidence from the Sima de los Huesos fossils published in 2016 seems to suggest that <em>H. heidelbergensis</em> in its entirety should be included in the Neanderthal lineage, as &quot;pre-Neanderthal&quot; or &quot;early Neanderthal&quot;, while the divergence time between the Neanderthal and modern lineages has been pushed back to before the emergence of <em>H. heidelbergensis</em>,</td>
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to about 600,000 to 800,000 years ago, the approximate age of *Homo antecessor*.

Solidified footprints dated to about 350 ka and associated with *H. heidelbergensis* were found in southern Italy in 2003.

**Homo sapiens**

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<th>Date</th>
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<tr>
<td>300–130 ka</td>
<td>Fossils attributed to <em>H. sapiens</em>, along with stone tools, dated to approximately 300,000 years ago, found at Jebel Irhoud, Morocco yield the earliest fossil evidence for anatomically modern <em>Homo sapiens</em>. Modern human presence in East Africa (Gademotta), at 276 kya. A 177,000-year-old jawbone fossil discovered in Israel in 2017 is the oldest human remains found outside Africa. However, in July 2019, anthropologists reported the discovery of 210,000 year old remains of a <em>H. sapiens</em> and 170,000 year old remains of a <em>H. neanderthalensis</em> in Apidima Cave, Peloponnese, Greece, more than 150,000 years older than previous <em>H. sapiens</em> finds in Europe. Neanderthals emerge from the <em>Homo heidelbergensis</em> lineage at about the same time (300 ka). Patrilineal and matrilineal most recent common ancestors (MRCAs) of living humans roughly between 200 and 100 ka with some estimates on the patrilineal MRCA somewhat higher, ranging up to 250 to 500 kya. 160,000 years ago, <em>Homo sapiens idaltu</em> in the Awash River Valley (near present-day Herto village, Ethiopia) practiced excarnation.</td>
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Last Glacial Maximum; Epipaleolithic / Mesolithic / Holocene. Peopling of the Americas. Appearance of: Y-Haplogroup R1a; mt-haplogroups V and T. Various recent divergence associated with environmental pressures, e.g. light skin in Europeans and East Asians (KITLG, ASIP), after 30 ka; Inuit adaptation to high-fat diet and cold climate, 20 ka.

Extinction of late surviving archaic humans at the beginning of the Holocene (12 ka). Accelerated divergence due to selection pressures in populations participating in the Neolithic Revolution after 12 ka, e.g. East Asian types of ADH1B associated with rice domestication, or lactase persistence.

**Timeline of historic inventions**

**Paleolithic**

The dates listed in this section refer to the earliest evidence of an invention found and dated by archaeologists (or in a few cases, suggested by indirect evidence). Dates are often approximate and change as more research is done, reported and seen. Older examples of any given technology are found often. The locations listed are for the site where the earliest solid evidence has been found, but especially for the earlier inventions, there is little certainty how close that may be to where the invention took place.

**Lower Paleolithic**

The Lower Paleolithic period lasted over 3 million years, and corresponds to the human species prior to the emergence of *Homo sapiens*. The original divergence between humans and chimpanzees occurred 13 (Ma), however interbreeding continued until as recently as 4 Ma, with the first species clearly belonging to the human (and not chimpanzee) lineage being the *Australopithecus anamensis*. This time period is characterized as an ice age with regular periodic warmer periods – interglacial episodes.

- 3.3-2.6 Ma: Stone tools – found in present-day Kenya, they are so old that only a pre-human species could have invented them. The otherwise earliest known stone tools (Oldowan) were found in Ethiopia developed perhaps by *Australopithecus garhi* or *Homo habilis*
• 2.3 Ma: Earliest likely control of fire and cooking, by Homo habilis
• 1.76 Ma: Advanced (Acheulean) stone tools in Kenya by Homo erectus
• 1.5 Ma: Bone tools in Africa.
• 900-40 ka: Boats.
• 500 ka: Hafting in South Africa.
• 400 ka: Pigments in Zambia
• 400-300 ka: Spears in Germany likely by Homo heidelbergensis
• 350-150 ka: Estimated origin of language

Middle Paleolithic

The dawn of homo sapiens around 300 ka coincides with the start of the Middle Paleolithic period. Towards the middle of this 250,000-year period, humans begin to migrate out of Africa, and the later part of the period shows the beginning of long-distance trade, religious rites and other behavior associated with Behavioral modernity.

• c. 320 ka: The trade and long-distance transportation of resources (e.g. obsidian), use of pigments, and possible making of projectile points in Kenya
• 279 ka: Early stone-tipped projectile weapons in Ethiopia
• c. 200 ka: Glue in Central Italy by neanderthals. More complicated compound adhesives developed by homo sapiens have been found from c. 70 ka Sibudu, South Africa and have been regarded as a sign of cognitive advancement.
• 170-83 ka: Clothing (among anatomically modern humans in Africa). Some other evidence suggests that humans may have begun wearing clothing as far back as 100,000 to 500,000 years ago.
• 164-47 ka: Heat treating of stone blades in South Africa.
• 135-100 ka: Beads in Israel and Algeria
• 100 ka: Compound paints made in South Africa
• 100 ka: Funerals (in the form of burial) in Israel
• 90 ka: Harpoons in the Democratic Republic of the Congo.
• 77 ka: Beds in South Africa
• 70-60 ka: Oldest arrows (and evidence of bow-and-arrow technology), and oldest needle, at Sibudu, South Africa
Upper Paleolithic to Early Mesolithic

50 ka has been regarded by some as the beginning of Behavioral modernity, defining the Upper Paleolithic period, which lasted nearly 40,000 years (though some research dates the beginning of behavioral modernity earlier to the Middle Paleolithic). This is characterized by the widespread observation of religious rites, artistic expression and the appearance of tools made for purely intellectual or artistic pursuits.

- 49-30 ka: Ground stone tools – fragments of an axe in Australia date to 49-45 ka, more appear in Japan closer to 30 ka, and elsewhere closer to the Neolithic.
- 47 ka: The oldest-known mines in the world are from Swaziland, and extracted hematite for the production of the red pigment ochre.
- 44–42 ka: Tally sticks (see Lebombo bone) in Swaziland
- 43.7 ka: Cave painting in Indonesia
- 40-20 ka: Domestication of the Grey Wolf
- 37 ka: Mortar and pestle in Southwest Asia.
- 36 ka: Weaving – Indirect evidence from Czechia, Georgia and Moravia. The earliest actual piece of woven cloth was found in Çatalhöyük, Turkey
- 35 ka: Flute in Germany
- 33-10 ka: Star chart in France and Spain.
- 28 ka: Rope
- 28 ka: Phallus in Germany
- 26 ka: Ceramics in Europe.
- 19 ka: Bullroarer in Ukraine
- 16 ka: Pottery in China
- 14.5 ka: Bread in Jordan
- 14 ka: Dentistry in northern Italy

Agricultural and Proto-Agricultural Eras

The end of the Last Glacial Period ("ice age") and the beginning of the Holocene around 11.7 ka coincide with the Agricultural Revolution, marking the beginning of the agricultural era, which persisted until the industrial revolution.
Neolithic and Late Mesolithic

During the Neolithic period, lasting 8400 years, stone remained the predominant material for toolmaking, although copper and arsenic bronze were developed towards the end of this period.

- 12-11 ka: Agriculture in the Fertile Crescent
- 12–11 ka: Domestication of sheep in Southwest Asia (followed shortly by pigs, goats and cattle)
- 11-8 ka: Domestication of rice in China
- 11 ka: Constructed stone monument – Göbekli Tepe, in Turkey
- 9000 BC: Mudbricks, and clay mortar in Jericho.
- 8000–7500 BC: Proto-city – large permanent settlements, such as Tell es-Sultan (Jericho) and Çatalhöyük, Turkey.
- 7000 BC: Dental drill in the Indus Valley site of Mehrgarh, Pakistan.
- 7000 BC: Alcohol fermentation – specifically mead, in China
- 7000 BC: Sled dog and Dog sled, in Siberia.
- 7000 BC: Tanned leather in Mehrgarh, Pakistan.
- 6500 BC: Evidence of lead smelting in Çatalhöyük, Turkey
- 6000 BC: Kiln in Mesopotamia (Iraq)
- 6th millennium BC: Irrigation in Khuzistan, Iran
- 6000-3200 BC: Proto-writing in present day Egypt, Iraq, Serbia, China and Pakistan.
- 5000 BC: Copper smelting in Serbia
- 5000 BC: Seawall in Israel
- 5th millennium BC: Lacquer in China
- 5000 BC: Cotton thread, in Mehrgarh, Pakistan, connecting the copper beads of a bracelet.
- 5000–4500 BC: Rowing oars in China
- 4500–3500 BC: Lost-wax casting in Israel or the Indus Valley
- 4400 BC: Fired bricks in China.
- 4000 BC: Probable time period of the first diamond-mines in the world, in Southern India.
- Around 4000 BC: Paved roads, in and around the Mesopotamian city of Ur, Iraq.
- 4000 BC: Plumbing. The earliest pipes were made of clay, and are found at the Temple of Bel at Nippur in Babylonia. Earthen pipes were later used in the Indus Valley c. 2700 BC for a city-scale urban drainage system, and more durable copper drainage pipes appeared in Egypt, by the time of the construction of the Pyramid of Sahure at Abusir, c.2400 BCE.
• 4000–3500 BC: Wheel: potter's wheels in Mesopotamia and wheeled vehicles in Mesopotamia (Sumerian civilization), the Northern Caucasus (Maykop culture) and Central Europe (Cucuteni–Trypillia culture).

• 3630 BC: Silk garments (sericulture) in China

• 3500 BC: Domestication of the horse

• 3500 BC: Wine as general anesthesia in Sumer.

• 3500 BC: Seal (emblem) invented around in the Near East, at the contemporary sites of Uruk in southern Mesopotamia and slightly later at Susa in south-western Iran during the Proto-Elamite period, and they follow the development of stamp seals in the Halaf culture or slightly earlier.

• 3400-3100 BC: Tattoos in southern Europe

**Bronze Age**

The beginning of bronze-smelting coincides with the emergence of the first cities and of writing in the Ancient Near East and the Indus Valley. The Bronze Age is taken as a 2000-year long period starting in 3300 BC and ending in 1300 BC.

• 3300 BC: City in Sumer.

• 3300 BC: Writing – Cuneiform in Sumer, Mesopotamia (Iraq)

• 3300 BC: Copper-tin bronze in Sumer.

• Before 3200 BC: dry Latrines in the city of Uruk, Iraq, with later dry squat Toilets, that added raised fired brick foot platforms, and pedestal toilets, all over clay pipe constructed drains.

• 3200 BC: Sailing in ancient Egypt

• Before 3000 BC: Devices functionally equivalent to dice, in the form of flat two-sided throwsticks, are seen in the Egyptian game of Senet. Later, terracotta dice resembling modern ones were used at the Indus Valley site of Mohenjo-Daro (Pakistan).

• 3000 BC: Tin extraction in Central Asia

• 3000 BC: Bronze in Mesopotamia

• 3000-2560 BC: Papyrus in Egypt

• 3000 BC: Comb in Persia.

• 3000 BC: Reservoir in Girnar, Indus Valley (India).

• 3000 BC: Distillation in Indus Valley (modern-day Pakistan).

• 3000 BC: Sea-going ships by Austronesians (modern-day Southern China, Taiwan)

• 3000 BC: Receipt in Ancient Mesopotamia (Iraq)

• 2800 BC: Latest possible data for invention of ploughing, Kalibangan, Indus Valley (India).
• c. 2600 BC: Planned city in Indus Valley (India, Pakistan).
• By 2650 BC: The Ruler, or Measuring rod, in the subdivided Nippur, copper rod. Shell, Terracotta, Copper, and Ivory rulers were in use by the Indus Valley Civilisation in what today is Pakistan, and North West India, prior to 1500 BCE.
• c. 2600 BC: Public sewage and sanitation systems in Indus Valley sites such as Mohenjo-Daro and Rakhigarhi.
• c. 2600 BC: Public bath in Mohenjo-daro, Indus Valley (Pakistan).
• 2600 BC: Levee in Indus Valley (India, Pakistan).
• By 2556 BC: Docks in either Egypt or the Indus Valley. A harbor structure has been excavated in Wadi al-Jarf, which is believed to have been developed during the reign of the Pharoah Khufu (2589–2566 B.C). A competing claim is from Lothal dockyard in India, constructed at some point between 2400-2000 BC; however, more precise dating does not exist.
• 3000-2500 BC: Rhinoplasty in Egypt.
• 2500 BC: Puppetry in the Indus Valley.
• 2500 BC: Dictionary in Mesopotamia
• c. 2400 BC: Copper pipes, the Pyramid of Sahure, and adjoining temple complex at Abusir, was discovered to have a network of copper drainage pipes.
• after 2400 BC: Protractor in Lothal, Indus Valley (Present day India).
• after 2400 BC: Weighing scales in Lothal, Indus Valley (India).
• 2400 BC: Touchstone in the Indus Valley site of Banawali (India).
• Around 2000 BC: Water clock by at least the old Babylonian period (c. 2000 – c. 1600 BC), but possibly earlier from Mohenjo-Daro in the Indus Valley.
• 2000 BC: Musical notation in Sumer
• 2000 BC: Chariot in Russia and Kazakhstan
• 2000 BC: Glass in Ancient Egypt
• By at least 1500 BC: Sundial in Babylonia.
• 1500 BC: Seed drill in Babylonia
• 1500 BC: Scissors in Ancient Egypt
• before 1400 BC: rubber, Mesoamerican ballgame.
• 1300 BC: Lathe in Ancient Egypt
• 1400-1200 BC: Concrete in Tiryns (Mycenaean Greece). Waterproof concrete was later developed by the Assyrians in 688 BC, and the Romans developed concretes that could set underwater. The Romans later used concrete extensively for construction from 300 BC to 476 AD.
Iron Age

The Late Bronze Age collapse occurs around 1300-1175 BC, extinguishing most Bronze-Age Near Eastern cultures, and significantly weakening the rest. This is coincident with the complete collapse of the already-fledgling Indus Valley Civilisation. This event is followed by the beginning of the Iron Age. We define the Iron Age as ending in 510 BC for the purposes of this article, even though the typical definition is region-dependent (e.g. 510 BC in Greece, 322 BC in India, 200 BC in China), thus being an 800-year period.

It’s worth noting the uncertainty in dating several Indian developments between 600 BC and 300 AD, due to the tradition that existed of editing existing documents (such as the Sushruta Samhita and Arthashastra) without specifically documenting the edit. Most such documents were canonized at the start of the Gupta empire (mid-3rd century AD).

- 1300 BC: Iron smelting in either India or the Middle East.
- By 800 BC: Reconstructive surgery in India.
- 700 BC: Grammar in Northern India (note: Sanskrit Vyākaraṇa predates Pāṇini).
- 700 BC: Saddle (fringed cloths or pads used by Assyrian cavalry).
- 650 BC: Crossbow in China.
- 600 BC: Coins in Phoenicia (Modern Lebanon) or Lydia.
- Late 7th or early 6th century BC: Wagonway called Diolkos across the Isthmus of Corinth in Ancient Greece.
- 6th century BC: Steel (as Wootz steel) in South India.
- 6th century BC: First known (probably accidental) ancient use of nanoparticles in Wootz Steel in South India. Later uses include the Roman Lycurgus Cup.
- 6th century BC: Crucible method in South India.
- 6th century BC: University in Taxila in Ancient India (modern-day Pakistan).
- 6th century BC: Systematization of medicine and surgery in the Sushruta Samhita in Vedic Northern India.
- 6th to 2nd centuries BC (historical layers of the development of the Sushruta Samhita): Cataract surgery (Couching) in the Sushruta Samhita in Vedic or Mauryan India.
- 6th to 2nd centuries BC: Caesarean section in the Sushruta Samhita (India).
- 6th to 2nd centuries BC: Prosthetic limb in the Sushruta Samhita (India).
- 6th to 2nd centuries BC: Plastic surgery in the Sushruta Samhita (India).
- Late 6th century BC: Crank motion (rotary quern) in Carthage or 5th century BC Celtiberian Spain. Later during the Roman empire, a mechanism appeared that incorporated a connecting rod.
• Before 5th century BC: Loan deeds in Upanishadic India.
• c. 515 BC: Crane in Ancient Greece
• 500 BC Lighthouse in Greece

Classical antiquity and medieval era

5th century BC

• 500 BC: The earliest manifestation of the stirrup was widely used in India in the 2nd century BC, although may have originated as early as 500 BC.
• 485 BC: Catapult by Ajatashatru in Magadha, India.
• 485 BC: Scythed chariot by Ajatashatru in Magadha, India.
• 5th century BC: Cast iron in Ancient China: Confirmed by archaeological evidence, the earliest cast iron is developed in China by the early 5th century BC during the Zhou Dynasty (1122–256 BC), the oldest specimens found in a tomb of Luhe County in Jiangsu province.
• c. 480 BC: Spiral stairs (Temple A) in Selinunte, Sicily (see also List of ancient spiral stairs)
• By 407 BC: Wheelbarrow in Greece.

4th century BC

• 4th century BC: Traction trebuchet in Ancient China.
• 4th century BC: Gears in Ancient China
• 4th century BC: Reed pens, utilising a split nib, were used to write, with ink, on Papyrus, in Egypt.
• 4th century BC: Pens (sharp pointed needles used with ink) in South India.
• Approximately 350 BC: Greek hydraulic semaphore system, an optical communication system developed by Aeneas Tacticus.
• By the late 4th century BC: Corporations in either the Maurya Empire of India or in Ancient Rome (Collegium).
• Late 4th century BC: Cheque in the Maurya Empire of India.
• Late 4th century BC: Potassium nitrate manufacturing and military use in the Maurya Empire, India.
• Late 4th century BC: Formal systems by Pāṇini in India, possibly during the reign of Chandragupta Maurya.
• 4th to 3rd century BC: Zinc production in North-Western India during the Maurya Empire. The earliest known zinc mines and smelting sites are from Zawar, near Udaipur, in Rajasthan.

3rd century BC

• By 3rd century BC: Automatons in either the Hellenistic world or India. Kautilya's Arthashastra describes the use of *calayantras* (dynamic devices) such as automatic doors in Indian warfare. Later commentaries and texts describe a theoretic foundation for the engineering of basic automatons, describing them as compositions of simple machines operating through pressure, rotation and weight. However robots remained foreign to India at the time, with a Hindu-Buddhist tale attributing their invention to the Hellenistic world.

• 3rd century BC: Analog computers in the Hellenistic world (see e.g. the Antikythera mechanism), possibly in Rhodes.

• By at least the 3rd century BC: Archimedes screw in Ancient Greece

• Early 3rd century BC: Canal lock in Ancient Suez Canal under Ptolemy II (283–246 BC) in Hellenistic Egypt

• 3rd century BC: Cam during the Hellenistic period, used in water-driven automata.

• By the 3rd century BC: Water wheel. The origin is unclear: Indian Pali texts dating to the 4th century BCE refer to the *cakkavattaka*, which later commentaries describe as *arahatta-ghati-yanta* (machine with wheel-pots attached). Helaine Selin suggests that the device existed in Persia before 350 BC. The clearest description of the water wheel and Liquid-driven escapement is provided by Philo of Byzantium (c. 280 – 220 BC) in the Hellenistic kingdoms.

• 3rd century BC: Gimbal described Philo of Byzantium

• Late 3rd century BC: Dry dock under Ptolemy IV (221–205 BC) in Hellenistic Egypt

• 3rd–2nd century BC: Blast furnace in Ancient China: The earliest discovered blast furnaces in China date to the 3rd and 2nd centuries BC, although most sites are from the later Han Dynasty.

2nd century BC

• 2nd century BC: Paper in Han Dynasty China: Although it is recorded that the Han Dynasty (202 BC – AD 220) court eunuch Cai Lun (born c. 50–121 AD) invented the pulp papermaking process and established the use of new raw materials used in making paper, ancient padding and wrapping paper artifacts dating to the 2nd century BC have been found in China, the oldest example of pulp papermaking being a map from Fangmatan, Gansu.
- Early 2nd century BC: Astrolabe invented by Apollonius of Perga.

**1st century BC**

- 1st century BC: Segmental arch bridge (e.g. Pont-Saint-Martin or Ponte San Lorenzo) in Italy, Roman Republic
- 1st century BC: News bulletin during the reign of Julius Caesar. A paper form, i.e. the earliest newspaper, later appeared during the late Han dynasty in the form of the Dibao.
- 1st century BC: Arch dam (Glanum Dam) in Gallia Narbonensis, Roman Republic (see also List of Roman dams)
- Before 40 BC: Trip hammer in China
- 38 BC: an empty shell Glyph for zero, is found on a Maya numerals Stela, from Chiapa de Corzo, Chiapas.
- Before 25 BC: Reverse overshot water-wheel by Roman engineers in Rio Tinto, Spain
- 37-14: Glass blowing developed in Jerusalem.

**1st century**

- 1st century: The Aeolipile, a simple steam turbine is recorded by Hero of Alexandria.
- 1st century: Vending machines invented by Hero of Alexandria.
- By the 1st century: The double-entry bookkeeping system in India.
- By 50 AD: Flamethrowers by the Early Cholas of Southern India (according to the Periplus of the Erythrean Sea).

**2nd century**

- 132: Seismometer and pendulum in Han Dynasty China, built by Zhang Heng. It is a large metal urn-shaped instrument which employed either a suspended pendulum or inverted pendulum acting on inertia, like the ground tremors from earthquakes, to dislodge a metal ball by a lever trip device.
- 2nd century: Carding in India.

**3rd century**

- By at least the 3rd century: Crystallized sugar in India.
- Early 3rd century: Woodblock printing is invented in Han Dynasty China at sometime before 220 AD. This made China become the world’s first print culture.
- Late 3rd–early 4th century: Water turbine in the Roman Empire in modern-day Tunisia.

4th century

- 280-550 AD: Chess in India during the Gupta Empire.
- By 4th century: Araghatta or Persian wheel in India.
- 4th century: Mariner's compass in Tamil Southern India: the first mention of the use of a compass for navigational purposes is found in Tamil nautical texts as the *macchayantra*. However, the theoretical notion of magnets pointing North predates the device by several centuries.
- 4th century: Iron suspension bridge in India.
- 4th century: Fishing reel in Ancient China: In literary records, the earliest evidence of the fishing reel comes from a 4th-century AD work entitled *Lives of Famous Immortals*.
- 347 AD: Oil Wells and Borehole drilling in China. Such wells could reach depths of up to 240 m (790 ft).
- 4th–5th century: Paddle wheel boat (in *De rebus bellicis*) in Roman Empire

5th century

- By the 5th century: Numerical zero in Ancient India: The concept of zero as a number, and not merely a symbol for separation is attributed to India. In India, practical calculations are carried out using zero, which is treated like any other number by at least the time of Aryabhata, even in case of division.
- 400 AD: The construction of the Iron pillar of Delhi in Mathura by the Gupta Empire shows the development of rust-resistant ferrous metallurgy in Ancient India, although original texts do not survive to detail the specific processes invented in this period.
- 5th century: Horse collar in Southern and Northern Dynasties China: The horse collar as a fully developed collar harness is developed in Southern and Northern Dynasties China during the 5th century AD. The earliest depiction of it is a Dunhuang cave mural from the Chinese Northern Wei Dynasty, the painting dated to 477–499.
- 5th/6th century: Pointed arch bridge (Karamagara Bridge) in Cappadocia, Eastern Roman Empire

6th century

- By the 6th century: Incense clock in India.
- after 500 AD: Charkha (spinning wheel/cotton gin): invented in India (probably during the Vakataka dynasty of Maharashtra), between 500 and 1000 A.D.
• 563 AD: Pendentive dome (Hagia Sophia) in Constantinople, Eastern Roman Empire

• 577 AD: Sulfur matches exist in China.

• 589 AD: Toilet paper in Sui Dynasty China, first mentioned by the official Yan Zhitui (531–591), with full evidence of continual use in subsequent dynasties.

7th century

• 650 AD Windmill in Persia

• 672 AD: Greek fire in Constantinople, Byzantine Empire: Greek fire, an incendiary weapon likely based on petroleum or naphtha, is invented by Kallinikos, a Lebanese Greek refugee from Baalbek, as described by Theophanes. However, the historicity and exact chronology of this account is dubious, and it could be that Kallinikos merely introduced an improved version of an established weapon.

• 7th century: Banknote in Tang Dynasty China: The banknote is first developed in China during the Tang and Song dynasties, starting in the 7th century. Its roots are in merchant receipts of deposit during the Tang Dynasty (618–907), as merchants and wholesalers desire to avoid the heavy bulk of copper coinage in large commercial transactions.

• 7th century: Porcelain in Tang Dynasty China: True porcelain is manufactured in northern China from roughly the beginning of the Tang Dynasty in the 7th century, while true porcelain was not manufactured in southern China until about 300 years later, during the early 10th century.

8th century

• 700 AD: Manmade pinhole camera, still extant, in the Virupaksha Temple in Karnataka, India, during the Chalukyas of Vatapi.

9th century

• 9th century: Gunpowder in Tang Dynasty China: Gunpowder is, according to prevailing academic consensus, discovered in the 9th century by Chinese alchemists searching for an elixir of immortality. Evidence of gunpowder's first use in China comes from the Five Dynasties and Ten Kingdoms period (618–907). The earliest known recorded recipes for gunpowder are written by Zeng Gongliang, Ding Du, and Yang Weide in the Wujing Zongyao, a military manuscript compiled in 1044 during the Song Dynasty (960–1279).

• 9th century: Degree-granting university in Morocco

10th century
• 10th century: Fire lance in Song Dynasty China, developed in the 10th century with a tube of first bamboo and later on metal that shot a weak gunpowder blast of flame and shrapnel, its earliest depiction is a painting found at Dunhuang. Fire lance is the earliest firearm in the world and one of the earliest gunpowder weapons.

• 10th century: Fireworks in Song Dynasty China: Fireworks first appear in China during the Song Dynasty (960–1279), in the early age of gunpowder. Fireworks could be purchased from market vendors; these were made of sticks of bamboo packed with gunpowder.

11th century

• 11th century: Ambulance by Crusaders in Palestine and Lebanon
• 11th century: Early versions of the Bessemer process are developed in China.
• 11th century: Endless power-transmitting chain drive by Su Song for the development an astronomical clock (the Cosmic Engine)
• 1088: Movable type in Song Dynasty China: The first record of a movable type system is in the Dream Pool Essays, which attributes the invention of the movable type to Bi Sheng.

12th century

• 12th century: Bond trading in France.

13th century

• 13th century: Rocket for military and recreational uses date back to at least 13th-century China.
• 13th century: The earliest form of mechanical escapement, the verge escapement in Europe.
• 13th century: Buttons (combined with buttonholes) as a functional fastening or closing clothes appear first in Germany.
• 1277: Land mine in Song Dynasty China: Textual evidence suggests that the first use of a land mine in history is by a Song Dynasty brigadier general known as Lou Qianxia, who uses an 'enormous bomb' (huo pao) to kill Mongol soldiers invading Guangxi in 1277.
• 1286: Eyeglasses in Italy
• 13th century: Explosive bomb in Jin dynasty Manchuria: Explosive bombs are used in 1221 by the Jin dynasty against a Song Dynasty city. The first accounts of bombs made of cast iron shells packed with explosive gunpowder are documented in the 13th century in China and are called "thunder-crash bombs", coined during a Jin dynasty naval battle in 1231.
• 13th century: Hand cannon in Yuan Dynasty China: The earliest hand cannon dates to the 13th century based on archaeological evidence from a Heilongjiang excavation. There is also written evidence in the *Yuanshi* (1370) on Li Tang, an ethnic Jurchen commander under the Yuan Dynasty who in 1288 suppresses the rebellion of the Christian prince Nayan with his "gun-soldiers" or *chongzu*, this being the earliest known event where this phrase is used.

• 13th or 14th century: worm gear cotton gin in Peninsular India (i.e. probably under the Yadava dynasty although may also be the Vijayanagara Empire or Bahmani Sultanate).

14th century

• Early to Mid 1300s: Multistage rocket in Ming Dynasty China described in *Huolongjing* by Jiao Yu.
• By at least 1326: Cannon in Ming Dynasty China
• 14th century: Jacob's staff invented by Levi ben Gerson
• 14th century: Naval mine in Ming Dynasty China: Mentioned in the *Huolongjing* military manuscript written by Jiao Yu (fl. 14th to early 15th century) and Liu Bowen (1311–1375), describing naval mines used at sea or on rivers and lakes, made of wrought iron and enclosed in an ox bladder. A later model is documented in Song Yingxing's encyclopedia written in 1637.

15th century

• Early 15th century: Coil spring in Europe
• 15th century: Mainspring in Europe
• 15th century: Rifle in Europe
• 1420s: Brace in Flandres, Holy Roman Empire
• 1439: Printing press in Mainz, Germany: The printing press is invented in the Holy Roman Empire by Johannes Gutenberg before 1440, based on existing screw presses. The first confirmed record of a press appeared in a 1439 lawsuit against Gutenberg.
• Mid 15th Century: The Arquebus (also spelled Harquebus) is invented, possibly in Spain.
• 1480s: Mariner's astrolabe in Portuguese circumnavigation of Africa

16th century

• 1560: Floating Dry Dock in Venice, Venetian Republic
• 1569: Mercator Projection map created by Gerardus Mercator
• 1589: Stocking frame: Invented by William Lee.
• 1594: Backstaff: Invented by Captain John Davis.
• By at least 1597: Revolver: Invented by Hans Stooler.

Modern era

17th century

• 1605: Newspaper (Relation): Johann Carolus in Strassburg, Holy Roman Empire of the German Nation (see also List of the oldest newspapers)
• 1608: Telescope: Patent applied for by Hans Lippersheyn in the Netherlands. Actual inventor unknown since it seemed to already be a common item being offered by the spectacle makers in the Netherlands with Jacob Metius also applying for patent and the son of Zacharias Janssen making a claim 47 years later that his father invented it.
• c. 1620: Compound microscopes, which combine an objective lens with an eyepiece to view a real image, first appear in Europe. Apparently derived from the telescope, actual inventor unknown, variously attributed to Zacharias Janssen (his son claiming it was invented in 1590), Cornelis Drebbel, and Galileo Galilei.
• 1630: Slide rule: invented by William Oughtred
• 1642: Mechanical calculator. The Pascaline is built by Blaise Pascal
• 1643: Barometer: invented by Evangelista Torricelli, or possibly up to three years earlier by Gasparo Berti.
• 1650: Vacuum pump: Invented by Otto von Guericke.
• 1656: Pendulum clock: Invented by Christiaan Huygens. It was first conceptualized in 1637 by Galileo Galilei but he was unable to create a working model.
• 1663: Friction machine: Invented by Otto von Guericke.
• 1680: Christiaan Huygens provides the first known description of a piston engine.

18th century

1700s

• 1701: Jethro Tull invented the first seed drill.
• c. 1709: Bartolomeo Cristofori crafts the first piano.
• 1709: Daniel Gabriel Fahrenheit invents the alcohol thermometer.

1710s
• 1712: Thomas Newcomen builds the first commercial steam engine to pump water out of mines. Newcomen's engine, unlike Thomas Savery's, uses a piston.

1730s

• c. 1730: Thomas Godfrey and John Hadley independently develop the octant
• 1733: John Kay enables one person to operate a loom with the flying shuttle
• 1736: John Harrison tests his first Sea Clock, H1.
• 1738: Lewis Paul and John Wyatt invent the first mechanized cotton spinning machine.

1740s

• 1745: Musschenbroek and Kleist independently develop the Leyden jar, an early form of capacitor.
• 1746: John Roebuck invents the lead chamber process.

1750s

• 1755: William Cullen invents the first artificial refrigeration machine.

1760s

• 1764: James Hargreaves invents the spinning jenny.
• 1765: James Watt invents the improved steam engine utilizing a separate condenser.
• 1767: Joseph Priestley invents a method for the production of carbonated water.
• 1769: Nicolas-Joseph Cugnot invents the first steam-powered vehicle capable of carrying passengers, an early car.

1770s

• 1770: Richard Salter invents the earliest known design for a weighing scale.
• 1774: John Wilkinson invents his boring machine, considered by some to be the first machine tool.
• 1775: Jesse Ramsden invents the modern screw-cutting lathe.
• 1776: John Wilkinson invents a mechanical air compressor that would become the prototype for all later mechanical compressors.

1780s
- 1783: Claude de Jouffroy builds the first steamboat.
- 1783: Joseph-Ralf and Jacques-Étienne Montgolfier build the first manned hot air balloon.
- 1785: Martinus van Marum is the first to use the electrolysis technique.
- 1786: Andrew Meikle invents the threshing machine.
- 1789: Edmund Cartwright invents the power loom.

1790s

- 1790: Thomas Saint invents the sewing machine.
- 1792: Claude Chappe invents the modern semaphore telegraph.
- 1793: Eli Whitney invents the modern cotton gin.
- 1795: Joseph Bramah invents the hydraulic press.
- 1796: Alois Senefelder invents the lithography printing technique.
- 1797: Samuel Bentham invents plywood.
- 1798: Edward Jenner develops the first successful vaccine, the smallpox vaccine.
- 1799: George Medhurst invents the first motorized air compressor.
- 1799: The first paper machine is invented by Louis-Nicolas Robert.

19th century

1800s

- 1800: Alessandro Volta invents the voltaic pile, an early form of battery in Italy, based on previous works by Luigi Galvani.
- 1802: Humphry Davy invents the arc lamp (exact date unclear; not practical as a light source until the invention of efficient electric generators).
- 1804: Friedrich Sertürner discovers morphine as the first active alkaloid extracted from the opium poppy plant.
- 1804: Richard Trevithick invents the steam locomotive.
- 1804: Hanaoka Seishū creates tsūzensan, the first modern general anesthetic.
- 1807: Nicéphore Niépce invents the first internal combustion engine capable of doing useful work.
- 1807: François Isaac de Rivaz designs the first automobile powered by an internal combustion engine fuelled by hydrogen.
• 1807: Robert Fulton expands water transportation and trade with the workable steamboat.

1810s

• 1810: Nicolas Appert invents the canning process for food.
• 1811: Friedrich Koenig invents the first powered printing press, which was also the first to use a cylinder.
• 1812: William Reid Clanny pioneered the invention of the safety lamp which he improved in later years. Safety lamps based on Clanny's improved design were used until the adoption of electric lamps.
• 1814: James Fox invents the modern planing machine, though Matthew Murray of Leeds and Richard Roberts of Manchester have also been credited at times with its invention.
• 1816: Francis Ronalds builds the first working electric telegraph using electrostatic means.
• 1816: Robert Stirling invents the Stirling engine.
• 1817: Baron Karl von Drais invents the dandy horse, an early velocipede and precursor to the modern bicycle.
• 1818: Marc Isambard Brunel invents the tunnelling shield.

1820s

• 1822: Thomas Blanchard invents the pattern-tracing lathe (actually more like a shaper) and was completed by for the U.S. Ordnance Dept. The lathe can copy symmetrical shapes and is used for making gun stocks, and later, ax handles. The lathe's patent is in force for 42 years, the record for any U.S. patent.
• 1822: Nicéphore Niépce invents Heliography, the first photographic process.
• 1822: Charles Babbage, considered the "father of the computer", begins building the first programmable mechanical computer.
• 1823: Johann Wolfgang Döbereiner invents the first lighter.
• 1824: Johann Nikolaus von Dreyse invents the bolt-action rifle.
• 1825: William Sturgeon invents the electromagnet.
• 1826: John Walker invents the friction match.
• 1828: James Beaumont Neilson develops the hot blast process.
• 1828: Patrick Bell invents the reaping machine.
• 1828: Hungarian physicist Ányos Jedlik invents the first commutated rotary electromechanical machine with electromagnets.
• 1829: William Mann invents the compound air compressor.
1830s

- 1830: Edwin Budding invents the lawn mower.
- 1831: Michael Faraday invents a method of electromagnetic induction. It would be independently invented by Joseph Henry the following year.
- 1834: Moritz von Jacobi, a German-born Russian, invents the first practical electric motor.
- 1835: Joseph Henry invents the electromechanical relay.
- 1837: Samuel Morse invents Morse code.
- 1838: Moritz von Jacobi invents Electrotyping.
- 1839: William Otis invents the steam shovel.
- 1839: James Nasmyth invents the steam hammer.
- 1839: Edmond Becquerel invents a method for the photovoltaic effect, effectively producing the first solar cell.

1840s

- 1841: Alexander Bain devises a printing telegraph.
- 1842: William Robert Grove invents the first fuel cell.
- 1842: John Bennet Lawes invents superphosphate, the first man-made fertilizer.
- 1844: Friedrich Gottlob Keller and, independently, Charles Fenerty come up with the wood pulp method of paper production.
- 1846: Henri-Joseph Maus invents the Tunnel boring machine.
- 1847: Ascanio Sobrero invents Nitroglycerin, the first explosive made that was stronger than black powder.
- 1848: Jonathan J. Couch invents the pneumatic drill.
- 1849: Walter Hunt invents the first repeating rifle to use metallic cartridges (of his own design) and a spring-fed magazine.
- 1849: James B. Francis invents the Francis turbine.

1850s

- 1850: Sir William Armstrong invents the hydraulic accumulator.
- 1852: Robert Bunsen is the first to use a chemical vapor deposition technique.
- 1852: Elisha Otis invents the safety brake elevator.
1852: Henri Giffard becomes the first person to make a manned, controlled and powered flight using a dirigible.

1853: François Coignet invents reinforced concrete.

1855: James Clerk Maxwell invents the first practical method for color photography, whether chemical or electronic.

1855: Sir. Henry Bessemer patents the Bessemer process for making steel, with improvements made by others over the following years.

1856: James Harrison produces the world's first practical ice making machine and refrigerator using the principle of vapour compression in Geelong, Australia.

1856: William Henry Perkin invents Mauveine, the first synthetic dye.

1857: Heinrich Geissler invents the Geissler tube.

1859: Gaston Planté invents the lead acid battery, the first rechargeable battery.

1860: Joseph Swan produces carbon fibers.

1862: Alexander Parkes invents parkesine, also known as celluloid, the first man-made plastic.

1864: Louis Pasteur invents the pasteurization process.

1865: Carl Wilhelm Siemens and Pierre-Émile Martin invented the Siemens-Martin process for making steel.

1865: Gregor Mendel publishes 'Versuche über Pflanzenhybriden' ("Experiments on Plant Hybridization"), effectively founding the science of genetics, though the importance of his work would not be appreciated until later on.

1867: Alfred Nobel invents Dynamite, the first safely manageable explosive stronger than black powder.

1867: Lucien B. Smith invents barbed wire, which Joseph F. Glidden will modify in 1874, leading to the taming of the West and the end of the cowboys.

1872: J.E.T. Woods and J. Clark invented Stainless steel. Harry Brearley was the first to commercialize it.

1873: Frederick Ransome invents the rotary kiln.

1873: Sir William Crookes, a chemist, invents the Crookes radiometer as the by-product of some chemical research.

1873: Zénobe Gramme invents the first commercial electrical generator, the Gramme machine.
• 1874: Gustave Trouvé invents the first metal detector.
• 1876: Nicolaus August Otto invents the Four-stroke cycle.
• 1876: Alexander Graham Bell has a patent granted for the telephone. However, other inventors before Bell had worked on the development of the telephone and the invention had several pioneers.
• 1877: Thomas Edison invents the first working phonograph.
• 1878: Henry Fleuss is granted a patent for the first practical rebreather.
• 1878: Lester Allan Pelton invents the Pelton wheel.
• 1879: Joseph Swan and Thomas Edison both patent a functional Incandescent light bulb. Some two dozen inventors had experimented with electric incandescent lighting over the first three-quarters of the 19th century but never came up with a practical design. Swan's, which he had been working on his since the 1860s, had a low resistance so was only suited for small installations. Edison designed a high-resistance bulb as part of a large-scale commercial electric lighting utility.

1880s

• 1881: Nikolay Benardos presents carbon arc welding, the first practical arc welding method.
• 1884: Hiram Maxim invents the recoil-operated Maxim gun, ushering in the age of semi- and fully automatic firearms.
• 1884: Paul Vieille invents Poudre B, the first smokeless powder for firearms.
• 1884: Sir Charles Parsons invents the modern steam turbine.
• 1884: Hungarian engineers Károly Zipernowsky, Ottó Bláthy and Miksa Déri invent the closed core high efficiency transformer and the AC parallel power distribution.
• 1885: John Kemp Starley invents the modern bicycle.
• 1886: Carl Gassner invents the zinc-carbon battery, the first dry cell battery, making portable electronics practical.
• 1886: Charles Martin Hall and independently Paul Héroult invent the Hall–Héroult process for economically producing aluminum in 1886.
• 1886: Karl Benz invents the first petrol or gasoline powered auto-mobile (car).
• 1887: Carl Josef Bayer invents the Bayer process for the production of alumina.
• 1887: James Blyth invents the first wind turbine used for generating electricity.
• 1887: John Stewart MacArthur, working in collaboration with brothers Dr. Robert and Dr. William Forrest develops the process of gold cyanidation.
• 1888: John J. Loud invents the ballpoint pen.
1888: Heinrich Hertz publishes a conclusive proof of James Clerk Maxwell's electromagnetic theory in experiments that also demonstrate the existence of radio waves. The effects of electromagnetic waves had been observed by many people before this but no usable theory explaining them existed until Maxwell.

1890s

- 1890s: Frédéric Swarts invents the first chlorofluorocarbons to be applied as refrigerant.
- 1890: Clément Ader invents the first aircraft, airplane, fly machine called Eole (aircraft) or Ader Éole
- 1891: Whitcomb Judson invents the zipper.
- 1892: Léon Bouly invents the cinematograph.
- 1893: Rudolf Diesel invents the diesel engine (although Herbert Akroyd Stuart had experimented with compression ignition before Diesel).
- 1895: Guglielmo Marconi invents a system of wireless communication using radio waves.
- 1895: Wilhelm Conrad Röntgen invented the first radiograph (x-rays).
- 1898: Hans von Pechmann synthesizes polyethylene, now the most common plastic in the world.
- 1899: Waldemar Jungner invents the rechargeable nickel-cadmium battery (NiCd) as well as the nickel-iron electric storage battery (NiFe) and the rechargeable alkaline silver-cadmium battery (AgCd)

20th century

1900s

- 1900: The first Zeppelin is designed by Theodor Kober.
- 1901: The first motorized cleaner using suction, a powered "vacuum cleaner", is patented independently by British engineer Hubert Cecil Booth and American inventor David T. Kenney.
- 1903: The first successful gas turbine is invented by Ægidius Elling.
- 1903: Édouard Bénédictus invents laminated glass.
- 1903: First manually controlled, fixed wing, motorized aircraft flies at Kitty Hawk, North Carolina by Orville and Wilbur Wright. See Claims to the first powered flight.
- 1904: The Fleming valve, the first vacuum tube and diode, is invented by John Ambrose Fleming.
- 1907: The first free flight of a rotary-wing aircraft is carried out by Paul Cornu.
- 1907: Leo Baekeland invents bakelite.
- 1907 (at some time during the year), the tuyères thermopropulsives after 1945 (Maurice Roy (fr)) known as the statoreacteur a combustion subsonique (the ramjet) – R. Lorin
- 1908: Cellophane is invented by Jacques E. Brandenberger.
- 1909: Fritz Haber invents the Haber process.
- 1909: The first instantaneous transmission of images, or television broadcast, is carried out by Georges Rignoux and A. Fournier.

1910s

- 1911: The cloud chamber, the first particle detector, is invented by Charles Thomson Rees Wilson.
- 1913: The Bergius process is developed by Friedrich Bergius.
- 1913: The Kaplan turbine is invented by Viktor Kaplan.
- 1915: The first operational military tanks are designed, in Great Britain and France. They are used in battle from 1916 and 1917 respectively. In Britain the designers are Walter Wilson and William Tritton; in France, Eugène Brillié. (Although it is known that vehicles incorporating at least some of the features of the tank were designed in a number of countries from 1903 onwards, none reached a practical form.)
- 1916: The Czochralski process, widely used for the production of single crystal silicon, is invented by Jan Czochralski.
- 1917: The crystal oscillator is invented by Alexander M. Nicholson using a crystal of Rochelle Salt although his priority was disputed by Walter Guyton Cady

1920s

- 1925: The Fischer–Tropsch process is developed by Franz Fischer and Hans Tropsch at the Kaiser-Wilhelm-Institut für Kohlenforschung.
- 1926: The Yagi-Uda Antenna or simply Yagi Antenna is invented by Shintaro Uda of Tohoku Imperial University, Japan, assisted by his colleague Hidetsugu Yagi. The Yagi Antenna was widely used by the US, British, and Germans during World War II. After the war they saw extensive development as home television antennas.
- 1926: Robert H. Goddard launches the first liquid fueled rocket.
- 1927: The quartz clock is invented by Warren Harrison and J.W. Horton at Bell Telephone Laboratories.
- 1928: Penicillin is first observed to exude antibiotic substances by Nobel laureate Alexander Fleming. Development of medicinal penicillin is attributed to a team of medics and scientists including Howard Walter Florey, Ernst Chain and Norman Heatley.
- 1928: Philo Farnsworth demonstrates the first practical electronic television to the press.
• 1929: The ball screw is invented by Rudolph G. Boehm.

1930s

• 1930, the supersonic combusting ramjet (the turbojet) — Frank Whittle
• 1930: The Phase-contrast microscopy is invented by Frits Zernike.
• 1931: The electron microscope is invented by Ernst Ruska.
• 1933: FM radio is patented by inventor Edwin H. Armstrong.
• 1935: Nylon, the first fully synthetic fiber is produced by Wallace Carothers while working at DuPont.
• 1938: Z1 built by Konrad Zuse is the first freely programmable computer in the world.
• 1938, December: Nuclear fission discovered in experiment by Otto Hahn (Nazi Germany), coined by Lise Meitner (fled to Sweden from Nazi-occupied Austria) and Fritz Strassman (Sweden). The Manhattan Project, and consequently the Soviet atomic bomb project were begun based on this research, as well as the German nuclear energy project, although the latter one declined as its physicists were drafted into Germany's war effort.
• 1939: G. S. Yunyev or Naum Gurvich invented the electric current defibrillator

1940s

• 1940, February, Pu-239 isotope (isotope of plutonium) a form of matter existing with the capacity for use as a destructive element (because the isotope has an exponentially increasing spontaneous fission decay) within nuclear devices — Glenn Seaborg
• 1941: Polyester is invented by British scientists John Whinfield and James Dickson.
• 1942: The V-2 rocket, the world's first long range ballistic missile, developed in Nazi Germany during World War II.
• July 1945: The atomic bomb is first successfully developed by the United States, the United Kingdom and Canada as a part of the Manhattan Project and swiftly deployed in August 1945 in the atomic bombings of Hiroshima and Nagasaki, effectively terminating World War II.
• 1946: Sir James Martin invents the ejector seat, inspired by the death of his friend and test pilot Captain Valentine Baker in an aeroplane crash in 1942.
• 1947: Holography is invented by Dennis Gabor.
• 1947: Floyd Farris and J.B. Clark (Stanolind Oil and Gas Corporation) invents hydraulic fracturing technology.
• December 1947: The first transistor, a bipolar point-contact transistor, is invented by John Bardeen and Walter Brattain under the supervision of William Shockley at Bell Labs.
• 1948: The first atomic clock is developed at the United States's National Bureau of Standards.
• 1948: Basic oxygen steelmaking is developed by Robert Durrer. The vast majority of steel manufactured in the world is produced using the basic oxygen furnace; in 2000, it accounted for 60% of global steel output.

1950s

• 1950: The Toroidal chamber with axial magnetic fields (the Tokamak) is developed by Igor E. Tamm and Andrei D. Sakharov
• 1952: The float glass process is developed by Alastair Pilkington.
• December 20, 1951: First use of nuclear power to produce electricity for households in Arco, Idaho
• 1952: The first thermonuclear weapon is developed by the United States of America.
• 1953: The first video tape recorder, a helical scan recorder, is invented by Norikazu Sawazaki.
• 1954: Invention of Solar Battery by Bell Telephone scientists, Calvin Souther Fuller, Daryl Chapin and Gerald Pearson capturing the sun's power. First practical means of collecting energy from the sun and turning it into a current of electricity.
• 1955: The hovercraft is patented by Christopher Cockerell.
• 1955: The intermodal container is developed by Malcom McLean.
• 1956: The hard disk drive is invented by IBM.
• 1957: The first personal computer used by one person and controlled by a keyboard, the IBM 610, is invented in 1957 by IBM.
• 1957: The first artificial satellite, Sputnik 1, is built and launched by the Soviet Union.
• 1959: The MOSFET (MOS transistor) is invented by Mohamed Atalla and Dawon Kahng at Bell Labs. It is used in almost all modern electronic products. It was smaller, faster, more reliable and cheaper to manufacture than earlier bipolar transistors, leading to a revolution in computers, controls and communication.

1960s

• 1960: The first functioning laser is invented by Theodore Maiman.
• 1963: The first electronic cigarette is created by Herbert A. Gilbert. Hon Lik is often credited with its invention as he developed the modern electronic cigarette and was the first to commercialize it.
• 1965: Kevlar is invented by Stephanie Kwolek at DuPont.
• 1969: ARPANET first deployed via UCLA, SRI, UCSB, and The University of Utah.
1970s

- 1970: The pocket calculator is invented in Japan.
- 1971: Email is invented by Ray Tomlinson.
- 1971: The first single-chip microprocessor, the Intel 4004, is invented. Its development was led by Federico Faggin, using his silicon-gate MOS technology. This led to the personal computer (PC) revolution.
- 1972: The first video game console, used primarily for playing video games on a TV, is the Magnavox Odyssey.
- 1973: The first commercial graphical user interface is introduced in 1973 on the Xerox Alto. The modern GUI is later popularized by the Xerox Star and Apple Lisa.
- 1973: The first capacitive touchscreen is developed at CERN.
- 1973–74: The Internet protocol suite (TCP/IP) is proposed by Vinton Cerf and Robert E. Kahn for the Defense Advanced Research Projects Agency (DARPA) ARPANET, creating the basis for the modern Internet.
- 1975: Altair 8800 is the spark that ignited the microcomputer revolution.

1980s

- 1980: Flash memory (both NOR and NAND types) is invented in Japan by Fujio Masuoka while working for Toshiba. It is formally introduced to the public in 1984.
- 1982: A CD-ROM contains data accessible to, but not writable by, a computer for data storage and music playback. The 1985 Yellow Book standard developed by Sony and Philips adapted the format to hold any form of binary data.
- 1983: Stereolithography is invented by Chuck Hull
- 1984: The first commercially available cell phone, the DynaTAC 8000X, is created by Motorola.
- 1985: The lithium-ion battery is invented by John B. Goodenough, Rachid Yazami and Akira Yoshino. It has impacted modern consumer electronics and electric vehicles.

1990s

- 1990: The World Wide Web is first introduced to the public by English engineer and computer scientist Sir Tim Berners-Lee.
- 1993: Mosaic, the first popular web browser is introduced
1995: DVD is an optical disc storage format, invented and developed by Philips, Sony, Toshiba, and Panasonic in 1995. DVDs offer higher storage capacity than Compact Discs while having the same dimensions.

1998: The first portable MP3 player is released by SaeHan Information Systems.

21st century

2000s

2000: Sony develops the first prototypes for the Blu-ray optical disc format. The first prototype player was released in 2003.

2010s

2019: IBM launched IBM Q System One, its first integrated quantum computing system for commercial use.

Timeline of the nuclear program of Iran

1956–1979

1957: The United States and Iran sign a civil nuclear co-operation agreement as part of the U.S. Atoms for Peace program.

August 9, 1963: Iran signs the Partial nuclear test ban treaty (PTBT) and ratifies it on December 23, 1963.

1967: The Tehran Nuclear Research Centre is built and run by the Atomic Energy Organization of Iran (AEOI).

September 1967: The United States supplies 5.545 kg of enriched uranium, of which 5.165 kg contain fissile isotopes for fuel in a research reactor. The United States also supplies 112 g of plutonium, of which 104 g are fissile isotopes, for use as start-up sources for research reactor.

July 1968: Iran signs the Nuclear Non-Proliferation Treaty and ratifies it. It goes into effect on March 5, 1970.

1970s: Under the rule of Mohammad Reza Shah Pahlavi, plans are made to construct up to 20 nuclear power stations across the country with U.S. support and backing. Numerous contracts are signed with various
Western firms, and the German firm Kraftwerk Union (a subsidiary of Siemens AG) begins construction on the Bushehr power plant in 1974.

1974: the Atomic Energy Act of Iran was promulgated. The Act covers the activities for which the Atomic Energy Organization of Iran was established at that period. These activities included using atomic energy and radiation in industry, agriculture and service industries, setting up atomic power stations and desalination factories, producing source materials needed in atomic industries. This creates the scientific and technical infrastructure required for carrying out the said projects, as well as co-ordinating and supervising all matters pertaining to atomic energy in the country.

1974: The Shah lent $1 billion to the French Atomic Energy Commission to help build the Eurodif uranium processing company in Europe. In exchange, Iran received rights to 10% of the enriched uranium product, a right Iran never exercised. After a bitter legal dispute, the loan was repaid in 1991. Following the passage of United Nations Security Council Resolution 1737 in 2006, UN financial sanctions required France to freeze dividend payments to the Atomic Energy Organization of Iran.

1975: Massachusetts Institute of Technology signs a contract with the Atomic Energy Organization of Iran to provide training for Iranian nuclear engineers.

1975: Iran buys a 15% interest in the Rössing uranium mine of Namibia. However, due to international pressure, it is never allowed to collect any uranium from this outside country.

1979–1996

1979: Iran's Islamic revolution puts a freeze on the existing nuclear program and the Bushehr contract with Siemens AG is terminated as the German firm leaves.

1982: Iranian officials announced that they planned to build a reactor powered by their own uranium at the Isfahan Nuclear Technology Centre.

1983: International Atomic Energy Agency inspectors inspect Iranian nuclear facilities, and report on a proposed cooperation agreement to help Iran manufacture enriched uranium fuel as part of Iran's "ambitious program in the field of nuclear power reactor technology and fuel cycle technology." The assistance program is later terminated under U.S. pressure.

1984: Iranian radio announced that negotiations with Niger on the purchase of uranium were nearing conclusion.

1985: Iranian radio programs openly discuss the significance of the discovery of uranium deposits in Iran with the director of Iran’s Atomic Energy Organisation. also in this year Iran, Syria and Libya say that they should all develop nuclear weapons to counter the Israeli nuclear threat.
1989: the Radiation Protection Act of Iran was ratified in public session of April 9, 1989 by the Parliament and was approved by the Council of Law-Guardians on April 19, 1989.

1990: Iran begins negotiations with the Soviet Union regarding the re-construction of the Bushehr power plant.

1992: Iran signs an agreement with China for the building of two 950-megawatt reactors in Darkhovin (Western Iran). To date, construction has not yet begun.

1993: China provides Iran with an HT-6B Tokamak fusion reactor that is installed at the Plasma Physics Research Centre of Azad University.

January 1995: Iran signs an $800 million contract with the Russian Ministry of Atomic Energy (MinAtom) to complete a Light water reactor in Bushehr under IAEA safeguards.

1996: China and Iran inform the IAEA of plans to construct a nuclear enrichment facility in Iran, but China withdraws from the contract under U.S. pressure. Iran advises the IAEA that it plans to pursue the construction anyway.

2002–2004

August 2002: A spokesman for the MEK terrorist group holds a press conference to "expose" two nuclear facilities in Natanz and Arak that they claim to have discovered. However, the sites were already known to U.S. intelligence. Furthermore, under the terms of Iran's then-existing safeguards agreement with the IAEA, Iran was under no obligation to disclose the facilities while they were still under construction and not yet within the 180-day time limit specified by the safeguards agreement.

December 2002: The United States accuses Iran of attempting to make nuclear weapons.

Spring 2003: Iran makes a comprehensive proposal of negotiations with the United States that offers "full transparency for security that there are no Iranian endeavors to develop or possess WMD", joint decisive action against terrorists, coordination on a stable Iraq, coordination on nuclear matters, stop of any material support to Palestinian opposition groups (Hamas, Jihad etc.) resisting Israeli occupation, and a normalization of relationships. The offer is spurned by V.P. Cheney and the Bush administration, which instead criticizes the Swiss ambassador who forwarded the offer.

June 16, 2003: Mohamed ElBaradei, Director General of the International Atomic Energy Agency, declares that "Iran failed to report certain nuclear materials and activities" and requests "co-operative actions" from the country. The International Atomic Energy Agency does not at this time decide to declare Iran in non-compliance with its safeguards agreement under the Non-Proliferation Treaty.
October 21, 2003: As a confidence-building measure, Iran and the EU-3 agree to negotiations under the terms of the Paris Agreement, pursuant to which Iran agrees to temporarily suspend enrichment and permit more stringent set of nuclear inspections in accordance with the Additional Protocol, and the EU-3 explicitly recognizes Iran's right to civilian nuclear programs in accordance with the Non-Proliferation Treaty. The EU-3 submits a demand in August 2005 that Iran abandon enrichment nonetheless.

October 31, 2003: After negotiations with Iran and the US on language in the IAEA document, the IAEA declares that Iran has submitted a "comprehensive" declaration of its nuclear program.

November 11, 2003: The IAEA reports that Iran had many breaches and failures to comply with its safeguards agreement, including a "policy of concealment" from the IAEA, but also states that there is "no evidence" that Iran is attempting to build an atomic bomb.

November 13, 2003: The Bush administration claims that the IAEA conclusion of "no evidence" is "impossible to believe."

December 18, 2003: As agreed in the Paris Agreement, Iran voluntarily signs and implements the Additional Protocol to the Nuclear Non-Proliferation Treaty. Though the Protocol was not binding on Iran until ratified, Iran voluntarily agrees to permit expanded and more intensive IAEA inspections pursuant to the Protocol, which fail to turn up a nuclear weapons program in Iran. Iran ends the voluntary implementation of Additional Protocol after two years of inspections, as a protest to continued EU-3 demands that Iran abandon all enrichment.

June 2004: Kamal Kharrazi, Iran's foreign minister, responding to demands that Iran halt its nuclear program, says: "We won't accept any new obligations. Iran has a high technical capability and has to be recognised by the international community as a member of the nuclear club. This is an irreversible path."

June 14, 2004: Mohamed ElBaradei, Director General of the International Atomic Energy Agency, accuses Iran of "less than satisfactory" co-operation during the IAEA investigation of its nuclear program. ElBaradei demands "accelerated and proactive cooperation" from Iran which exceed the terms of Iran's legal obligations.

July 27, 2004: Iran removes seals placed upon uranium centrifuges by the International Atomic Energy Agency and resumes construction of the centrifuges at Natanz.

On June 29, 2004, IAEA Director General Mohammad ElBaradei announced that the Bushehr reactor was "not of international concern" since it was a bilateral Russian-Iranian project intended to produce nuclear energy.

July 31, 2004: Iran states that it has resumed building nuclear centrifuges to enrich uranium, reversing a voluntary October 2003 pledge to Britain, France, and Germany to suspend all uranium enrichment-related activities. The United States contends that the purpose is to produce weapons-grade uranium.
August 10, 2004: Several long-standing charges and questions regarding weapons-grade uranium samples found in Iran are clarified by the IAEA. Some samples match Pakistani and Russian sources which had contaminated imported Iranian equipment from those countries. The sources of the remaining samples remain unaccounted for.

August 24, 2004: Iranian Foreign Minister Kamal Kharrazi declares in Wellington, New Zealand, that Iran will retaliate with force against Israel or any nation that attempts a pre-emptive strike on its nuclear program. Earlier in the week, Israel's Chief of Staff, General Moshe Ya'alon, told an Israeli newspaper that "Iran is striving for nuclear capability and I suggest that in this matter [Israel] not rely on others."

September 6, 2004: The latest IAEA report finds that "unresolved issues surrounding Iran's atomic program are being clarified or resolved outright".

September 18, 2004: The IAEA unanimously adopts a resolution calling on Iran to suspend all activities related to uranium enrichment.

September 21, 2004: Iran announces that it will continue its nuclear program converting 37 tonnes of yellowcake uranium for processing in centrifuges.

October 18, 2004: Iran states that it is willing to negotiate with the U.K., Germany, and France regarding a suspension of its uranium enrichment activities, but that it will never renounce its right to enrich uranium.

October 24, 2004: The European Union makes a proposal to provide civilian nuclear technology to Iran in exchange for Iran terminating its uranium enrichment program permanently. Iran rejects this outright, saying it will not renounce its right to enrichment technologies. A decision to refer the matter from the International Atomic Energy Agency to the United Nations Security Council is expected on November 25, 2004.

November 15, 2004: Talks between Iran and three European Union members, the United Kingdom, France, and Germany, result in a compromise. Iran agrees to temporarily suspend its active uranium enrichment program for the duration of a second round of talks, during which attempts will be made at arriving at a permanent, mutually-beneficial solution.

November 15, 2004: A confidential UN report is leaked. The report states that all nuclear materials within Iran have been accounted for and there is no evidence of any military nuclear program. Nevertheless, it still cannot discount the possibility of such a program because it does not have perfect knowledge.

November 22, 2004: Iran declares that it will voluntarily suspend its uranium enrichment program to enter negotiations with the EU. Iran will review its decision in three months. The EU seeks to have the suspension made permanent and is willing to provide economic and political incentives.
November 24, 2004: Iran seeks to obtain permission from the European Union, in accordance with its recent agreement with the EU, to allow it to continue working with 24 centrifuges for research purposes.

November 28, 2004: Iran withdraws its demand that some of its technology be exempted from a freeze on nuclear enrichment activities.

2005

Jan 17, 2005: Iran offers a proposal to the EU. It includes: An Iranian commitment not to pursue weapons of mass destruction; cooperation on combating terrorism, and on regional security, including for Iraq and Afghanistan; and cooperation on strategic trade controls. The proposal was not accepted.

Mar 23, 2005: Iran offers a proposal to the EU including: Iran’s adoption of the IAEA Additional Protocol and continuous on-site inspections at key facilities; as well as limiting the expansion of Iran’s enrichment program, and a policy declaration of no reprocessing. The proposal was not accepted.

June 2005: U.S. Secretary of State Condoleezza Rice said IAEA head Mohamed ElBaradei should either "toughen his stance on Iran" or fail to be chosen for a third term as the agency's head. Following a one on one meeting between Rice and ElBaradei on June 9, the United States withdrew its opposition and ElBaradei was re-elected to his position on June 13, 2005.

August 5, 2005: The EU-3 submit a proposal to Iran pursuant to the Paris Agreement which requires Iran to permanently cease enrichment. The proposal is rejected by Iran as a violation of the Paris Agreement and Iran's Non-Proliferation Treaty rights.

Between August 8 and August 10, 2005: Iran resumed the conversion of uranium at the Isfahan facility, under IAEA safeguards, but did not engage in enrichment of uranium.

August 9, 2005: The Iranian Head of State, Ayatollah Ali Khamenei, issued a fatwa forbidding the production, stockpiling and use of nuclear weapons. The full text of the fatwa was released in an official statement at the meeting of the International Atomic Energy Agency in Vienna.

August 11, 2005: The 35-member governing board of the IAEA adopted a resolution calling upon Iran to suspend uranium conversion, and instructing ElBaradei to submit a report on Iran's nuclear program by September 3, 2005.

August 15, 2005: Iran's new president, Mahmoud Ahmadinejad, installed his new government. Iranian presidents do not have exclusive control over Iran's nuclear program, which falls mainly under the purview of Iran's Supreme Leader. Ali Larijani replaced Hassan Rowhani as secretary of the Supreme National Security Council, Iran's top policy-making body, with nuclear policy in his purview.
September 15, 2005: Ahmadinejad stated at a United Nations high-level summit that Iran has the right to develop a civil nuclear-power program within the terms of the 1970 treaty on the non-proliferation of nuclear weapons. He offered a compromise solution in which foreign companies would be permitted to invest and participate in Iran's nuclear program, which he said would ensure that it could not be secretly diverted to make nuclear weapons. The majority of the U.S. delegation left during his speech, but the U.S./UN mission denied there was a walkout.

September 24, 2005: The IAEA Board of Governors finds that the failures and breaches reported in November 2003 constitute non-compliance with Iran's safeguards agreement.

October 10, 2005: Iranian Oil Ministry Deputy for International Affairs Hadi Nejad-Hosseinian said that Iran could run out of oil reserves in nine decades.

November 5, 2005: The Iranian government approved a plan that allows foreign investors to participate in the work at the Natanz uranium enrichment plant. The cabinet also authorised the AEOI to take necessary measures to attract foreign and domestic investment in the uranium enrichment process.

November 19, 2005: The IAEA released a report saying that Iran blocked nuclear inspectors from the United Nations from conducting a second visit to a site known as Parchin military complex, where Iran was not legally required to allow inspections at all. The first inspections had failed to turn up any evidence of a nuclear program. IAEA Director-General Mohamed ElBaradei said in the report, "Iran's full transparency is indispensable and overdue." Separately, Iran confirmed that it had resumed the conversion of new quantities of uranium pursuant to its rights under the NPT, despite an IAEA resolution to stop such work.

2006

January 2006: Iran provides the European negotiating side with a six-point proposal, which includes an offer to again suspend uranium enrichment for a period of two years, pending the outcome of continued negotiations. The offer is dismissed by the Europeans, and not reported in the Western press. This offer of compromise follows several other offers from Iran, all of which were summarily dismissed by the US.

January 31, 2006: The IAEA reports that "Iran has continued to facilitate access under its Safeguards Agreement as requested by the Agency ... including by providing in a timely manner the requisite declarations and access to locations" and lists outstanding issues.

January 2006: The New York Times reporter James Risen published State of War, in which he alleged a CIA operation code-named Operation Merlin backfired and may have helped Iran in its nuclear program, in an attempt to delay it feeding them false information.
February 4, 2006: The IAEA votes 27-3 to report Iran to the United Nations Security Council. After the vote, Iran announced its intention to end voluntary co-operation with the IAEA beyond basic Nuclear Non-Proliferation Treaty requirements, and to resume enrichment of uranium.

March 2006: The U.S. National Security Strategy decried Iran, stating that "Iran has violated its Non-Proliferation Treaty safeguards obligations and refuses to provide objective guarantees that its nuclear program is solely for peaceful purposes." The term "objective guarantees" is understood to mean permanent abandonment of enrichment.

March 15, 2006: Mahmoud Ahmadinejad reaffirms Iran's commitment to developing a domestic nuclear power industry.

March 27, 2006: In a Foreign Policy article entitled "Fool Me Twice", Joseph Cirincione, director for non-proliferation at the Carnegie Endowment for International Peace, claimed that "some senior officials have already made up their minds: They want to hit Iran." and that there "may be a co-ordinated campaign to prepare for a military strike on Iran." Joseph Cirincione also warns "that a military strike would be disastrous for the United States. It would rally the Iranian public around an otherwise unpopular regime, inflame anti-American anger around the Muslim world, and jeopardise the already fragile U.S. position in Iraq. And it would accelerate, not delay, the Iranian nuclear program. Hard-liners in Tehran would be proven right in their claim that the only thing that can deter the United States is a nuclear bomb. Iranian leaders could respond with a crash nuclear program that could produce a bomb in a few years."

April 11, 2006: Ahmadinejad announced that Iran had enriched uranium to reactor-grade using 164 centrifuges. He said, "I am officially announcing that Iran has joined the group of those countries which have nuclear technology. This is the result of the Iranian nation's resistance. Based on international regulations, we will continue our path until we achieve production of industrial-scale enrichment". He reiterated that the enrichment was performed for purely civil power purposes and not for weapons purposes.

April 28, 2006: The International Atomic Energy Agency hands a report titled Implementation of the NPT Safeguards Agreement in the Islamic Republic of Iran to the UN Security Council. The IAEA says that Iran has stepped up its uranium enrichment programs during the 30-day period covered by the report.

June 1, 2006: The UN Security Council agrees to a set of proposals designed to reach a compromise with Iran.

July 31, 2006: United Nations Security Council Resolution 1696 gives until August 31, 2006 for Iran to suspend all uranium enrichment and related activities or face the prospect of sanctions. The draft passed by a vote of 14-1 (Qatar, which represents Arab states on the council, opposing). The same day, Iran's U.N. Ambassador Javad Zarif qualified the resolution as "arbitrary" and illegal because the NTP protocol explicitly guarantees under international law Iran’s right to pursue nuclear activities for peaceful purposes. In response to today’s vote at the UN, Iranian President Mahmoud Ahmadinejad said that his country will revise his position vis-à-vis the economic/incentive package offered previously by the G-6 (5 permanent Security council members plus Germany.)
September 16, 2006: (Havana, Cuba) All of the 118 Non-Aligned Movement member countries declare their support for Iran's nuclear program for civilian purposes in their final written statement. That is a clear majority of the 192 countries comprising the entire United Nations.

December 23, 2006: United Nations Security Council Resolution 1737 was unanimously passed by the United Nations Security Council. The resolution, sponsored by France, Germany and the United Kingdom, imposed sanctions against Iran for failing to stop its uranium enrichment program following resolution 1696. It banned the supply of nuclear-related technology and materials and froze the assets of key individuals and companies related to the enrichment program. The resolution came after the rejection of UN economic incentives for Iran to halt their nuclear enrichment program. The sanctions will be lifted if Iran suspends the "suspect activities" within 60 days to the satisfaction of the International Atomic Energy Agency.

2007

January 15, 2007: Ardeshir Hosseinpour, an Iranian junior scientist involved in The Uranium Conversion Facility at Isfahan, dies, reportedly due to "gassing". Several other scientists may also be killed or injured, and treated in nearby hospitals.

January 21, 2007: The death of Ardeshir Hosseinpour is finally reported by the Al-Quds daily and the Iranian Student's News Agency (in Arabic & Persian).

February 2, 2007: The U.S. private intelligence company Stratfor releases a report saying that Ardeshir Hosseinpour was killed by the Mossad through radioactive poisoning.

February 4, 2007: Reva Bhalla of Stratfor confirms the details of Stratfor's report to The Sunday Times. Despite the previous reports, the "semi-official" Fars News Agency reports that an unnamed informed source in Tehran told them that Ardeshir Hosseinpour was not involved in the nuclear facility at Isfahan, and that he "suffocated by fumes from a faulty gas fire in sleep."

March 6, 2007: Gholam Reza Aghazadeh, the head of Atomic Energy Organization of Iran declared that Iran has started construction of a domestically built nuclear power plant with capacity of 360 MW in Darkhovin, in southwestern Iran.

March 24, 2007: United Nations Security Council Resolution 1747 is adopted unanimously by the United Nations Security Council. In the resolution, the Council resolved to tighten the sanctions imposed on Iran in connection with that nation's nuclear program. It also resolved to impose a ban on arms sales and to step up the freeze on assets already in place.

April 9, 2007: President Ahmadinejad has announced Iran can now produce nuclear fuel on an industrial scale. Some officials said 3,000 uranium gas enrichment centrifuges were running at the Natanz plant in central Iran.
June 7, 2007: *Head of the International Atomic Energy Agency, Mohammad ElBaradei was quoted by the BBC as warning against the views of "new crazies who say 'let's go and bomb Iran'".

June 30, 2007: U.S. Congressional Representatives Mark S. Kirk and Robert E. Andrews proposed a bill to sanction against any company or individual that provides Iran with refined petroleum products. The plan is to pressure Iran over its nuclear program from December 31, 2007.

December 3, 2007: The U.S. Intelligence Community released a National Intelligence Estimate concluding that Iran "halted its nuclear weapons program" in 2003, but "is keeping open the option to develop nuclear weapons."

December 11, 2007: British spy chiefs have grave doubts that Iran has mothballed its nuclear weapons program, as a US intelligence report claimed last week, and believe the CIA has been hoodwinked by Tehran.

December 16, 2007: Iran's president said on Sunday the publication of a U.S. intelligence report saying Iran had halted a nuclear weapons program in 2003 amounted to a "declaration of surrender" by Washington in its row with Tehran.

**2008**

- March 4, 2008: The UN Security Council adopts Resolution 1803 - the third sanction resolution on Iran with a 14-0 vote (Indonesia abstained). The resolution extends financial sanctions to additional banks, extends travel bans to additional persons and bars exports to Iran of nuclear- and missile-related dual-use items.
- March 24, 2008: The last shipment of fuel and equipment arrives at the Bushehr Nuclear Power Plant.
- May 16, 2008: Iran offers proposed package to the UN, UN Security Council, Group of G+1 and submitted to Russia and China.

**2009**

- February 17: In Paris, International Atomic Energy Agency Director-General Mohamed ElBaradei said that Iran is still not helping United Nations nuclear inspectors find out whether it worked on developing an atom bomb in the past but Tehran has slowed its expansion of a key nuclear facility. "They haven't really been adding centrifuges, which is a good thing," ElBaradei said at a think-tank in Paris, adding: "Our assessment is that it's a political decision."

- June 5: IAEA releases report on Iran's compliance with the NPT. The IAEA claims the following: Access not granted for a recent inspection on May 19; access not granted since August 2008 to heavy water reactor at Arak; and, IAEA not given design information for reactor at Darkhovin. The IAEA further reports that
Iran has not implemented the Additional Protocol (a requirement of UN Security Council Resolution 1737) and has not cooperated in providing information which remains unclear or missing.

- June 19: El Baradei stated he had a "gut feeling that Iran definitely would like to have the technology" enabling it to possess nuclear weapons. He told the BBC that Iran wants to "send a message" to its neighbors and the rest of the world: "Don't mess" with Iran and "we can have nuclear weapons if we want to." Asked about voices in Israel who back a military strike against Iran to stop it from getting a nuclear weapon, El Baradei reiterated his opposition, saying "military action" would turn the region "into a ball of fire."

- July 8–10: On the 35th G8 summit, US president Obama said Iran will have to September (at the G20 meeting) to show some improvements on the negotiations about Iran's nuclear program, or else "face consequences". French president Nicolas Sarkozy said G8 are united on the issue with Iran, stating that patience with Iran was running thin: "For the past 6 years we have extended our hand saying stop your nuclear armament program... Do they want discussions or don't they want them? If they don't, there will be sanctions" he told reporters. Sarkozy also stated that Israel attacking Iran, would be an absolute catastrophe. "Israel should know that it is not alone and should follow what is going on calmly," he said, adding that he had not received any assurances that Israel would hold off on any action ahead of the September deadline.

- July 25: Mohammad Ali Jafari, Iran's Revolutionary Guards commander-in-chief, said that if Israel attacked Iran, Iran would strike Israel's nuclear facilities with their missiles: "Our missile capability puts all of the Zionist regime (Israel) within Iran's reach to attack," Jafari said.

- August 7: US Air Force General Charles Wald said that a devastating US military strike against Iran's nuclear and military facilities "is a technically feasible and credible option".

2010

- May 17: Iran, Turkey and Brazil announced a deal on procedures for a nuclear fuel swap aimed at easing concerns over Tehran's nuclear program.

- August 21: Iran acquires nuclear fuel rods from Russia

2011

- May 10, 2011: Iran’s Bushehr Nuclear Power Plant began operating at a low level.

- November 8, 2011: IAEA released a safeguards report that included detailed account of "possible military dimensions" to Iran's nuclear program. The Agency expressed serious concerns regarding Iran's "activities relevant to the development of a nuclear explosive device." According to information from the report, Parchin military complex has been used for testing high explosives that could be used in nuclear weapons. Yukiya Amano, Director General of the IAEA, also stated in his report that the Agency cannot
"conclude that all nuclear material in Iran is in peaceful activities," since "Iran is not providing the necessary cooperation."

2012

- January 2012: Iran announced it had begun uranium enrichment at the Fordo facility near Qom. The IAEA confirmed Iran started the production of uranium enriched to 20%.

2013

- March 2013: The United States began a series of secret negotiations with Iranian officials in Oman. The negotiations were kept hidden from other P5+1 partners. The White House asked journalists not to report on the talks.
- August 3, 2013: Hassan Rouhani was inaugurated as the president of Iran.
- November 11, 2013: Iran and the IAEA signed a Joint Statement on a Framework for Cooperation committing both parties to cooperate and resolve all present and past issues. As a first step, the Framework identified six practical measures to be completed within three months.
- November 24, 2013: Iran and the P5+1 reached an interim agreement (Joint Plan of Action).

2014

- July 20, 2014: Initial deadline for reaching a comprehensive agreement between the P5+1 and Iran. The deadline was extended to November 24, 2014.
- August 25, 2014: Iran has implemented three of the five specific steps agreed with the IAEA in May 2014 but failed to meet the deadline of 25 August on the other steps.

2015

- July 14, 2015: The P5+1 and Iran reached agreement on the Joint Comprehensive Plan of Action (JCPOA), which lifted Sanctions on Iran in exchange for limits on Iran's nuclear program and expanded IAEA verification.
April 30, 2018: Israeli Prime Minister Benjamin Netanyahu gave a speech on where he spoke of "new and conclusive proof of the secret nuclear weapons program that Iran has been hiding for years from the international community in its secret atomic archive."

May 8, 2018: U.S. President Donald Trump announced United States withdrawal from the Joint Comprehensive Plan of Action.

Timeline of speech and voice recognition

<table>
<thead>
<tr>
<th>Year</th>
<th>Month and date (if applicable)</th>
<th>Event type</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1877</td>
<td></td>
<td>Invention</td>
<td>Thomas Edison's phonograph becomes the first device to record and reproduce sound. The method is fragile, however, and is prone to damage.</td>
</tr>
<tr>
<td>1879</td>
<td></td>
<td>Invention</td>
<td>Thomas Edison invents the first dictation machine, a slightly improved version of his phonograph.</td>
</tr>
<tr>
<td>1936</td>
<td></td>
<td>Invention</td>
<td>A team of engineers at Bell Labs, led by Homer Dudley, begins work on the Voder, the first electronic speech synthesizer.</td>
</tr>
<tr>
<td>1939</td>
<td>March 21</td>
<td>Invention</td>
<td>Dudley is granted a patent for the Voder, US patent 2151091 A.</td>
</tr>
<tr>
<td>1939</td>
<td></td>
<td>Demonstration</td>
<td>The Voder is demonstrated at the 1939 [[Golden Gate International College] in [Nepal]]. A keyboard and footpaths where students used to have the machine emit speech.</td>
</tr>
<tr>
<td>1939–1940</td>
<td></td>
<td>Demonstration</td>
<td>The Voder is demonstrated at the 1939-1940 World's Fair in New York City.</td>
</tr>
<tr>
<td>1952</td>
<td></td>
<td>Invention</td>
<td>A team at Bell Labs designs the Audrey, a machine capable of understanding spoken digits.</td>
</tr>
<tr>
<td>1962</td>
<td></td>
<td>Demonstration</td>
<td>IBM demonstrates the Shoebox, a machine that can understand up to 16 spoken words in English, at the 1962 Seattle World's Fair.</td>
</tr>
<tr>
<td>1971</td>
<td></td>
<td>Invention</td>
<td>IBM invents the Automatic Call Identification system, enabling engineers to talk to and receive spoken answers from a device.</td>
</tr>
<tr>
<td>1971–1976</td>
<td></td>
<td>Program</td>
<td>DARPA funds five years of speech recognition research with the goal of ending up with a machine capable of understanding a minimum of 1,000 words. The program led to the creation of the Harpy by Carnegie Mellon, a machine capable</td>
</tr>
</tbody>
</table>
The hidden Markov model begins to be used in speech recognition systems, allowing machines to more accurately recognize speech by predicting the probability of unknown sounds being words.

IBM begins work on the Tangora, a machine that would be able to recognize 20,000 spoken words by the mid 1980s.

The invention of the World of Wonder's Julie Doll, a toy children could train to respond to their voice, brings speech recognition technology to the home.

Dragon launches Dragon Dictate, the first speech recognition product for consumers.

Speakable items, the first built-in speech recognition and voice enabled control software for Apple computers.

Sphinx-II, the first large-vocabulary continuous speech recognition system, is invented by Xuedong Huang.

IBM launches the MedSpeak, the first commercial product capable of recognizing continuous speech.

Microsoft integrates speech recognition into their Office products.

The National Security Agency begins using speech recognition to isolate keywords when analyzing recorded conversations.

Microsoft releases Windows Vista, the first version of Windows to incorporate speech recognition.

Google introduces GOOG-411, a telephone-based directory service. This will serve as a foundation for the company's future Voice Search product.

Google launches the Voice Search app for the iPhone, bringing speech recognition technology to mobile devices.

Apple announces Siri, a digital personal assistant. In addition to being able to recognize speech, Siri is able to understand the meaning of what it is told and take appropriate action.

Microsoft announces Cortana, a digital personal assistant similar to Siri.

Amazon announces the Echo, a voice-controlled speaker. The Echo is powered by Alexa, a digital personal assistant similar to Siri and Cortana. While Siri and Cortana are not the most important features of the devices on which they run, the Echo is dedicated to Alexa.
Timeline of solar cells

1800s

- 1839 - Alexandre Edmond Becquerel observes the photovoltaic effect via an electrode in a conductive solution exposed to light.
- 1873 - Willoughby Smith finds that selenium shows photoconductivity.
- 1874 - James Clerk Maxwell writes to fellow mathematician Peter Tait of his observation that light affects the conductivity of selenium.
- 1883 - Charles Fritts develops a solar cell using selenium on a thin layer of gold to form a device giving less than 1% efficiency.
- 1887 - Heinrich Hertz investigates ultraviolet light photoconductivity and discovers the photoelectric effect
- 1887 - James Moser reports dye sensitized photoelectrochemical cell.
- 1888-91 - Aleksandr Stoletov creates the first solar cell based on the outer photoelectric effect
- 1899 - Weston Bowser receives patent US598177, "solar storage."

1900–1929

- 1901 - Philipp von Lenard observes the variation in electron energy with light frequency.
- 1904 - Wilhelm Hallwachs makes a semiconductor-junction solar cell (copper and copper oxide).
- 1905 - Albert Einstein publishes a paper explaining the photoelectric effect on a quantum basis.
- 1914 - Sven Asen Berglund patents "methods of increasing the capacity of photosensitive cells."
- 1916 - Robert Millikan conducts experiments and proves the photoelectric effect.
- 1918 - Jan Czochralski produces a method to grow single crystals of metal. Decades later, the method is adapted to produce single-crystal silicon.
- 1921 - Einstein awarded the Nobel Prize in Physics for his work on the photoelectric effect.
1930–1959

- 1932 - Audobert and Stora discover the photovoltaic effect in Cadmium selenide (CdSe), a photovoltaic material still used today.
- 1941 - Russell Ohl files patent US2402662, "Light sensitive device."
- 1948 - Gordon Teal and John Little adapt the Czochralski method of crystal growth to produce single-crystalline germanium and, later, silicon.
- 1950s - Bell Labs produce solar cells for space activities.
- 1953 - Gerald Pearson begins research into lithium-silicon photovoltaic cells.
- 1954 - On April 25, 1954, Bell Labs announces the invention of the first practical silicon solar cell. Shortly afterwards, they are shown at the National Academy of Science Meeting. These cells have about 6% efficiency. The New York Times forecasts that solar cells will eventually lead to a source of "limitless energy of the sun."
- 1955 - Western Electric licences commercial solar cell technologies. Hoffman Electronics-Semiconductor Division creates a 2% efficient commercial solar cell for $25/cell or $1,785/watt.
- 1957 - AT&T assigns (Gerald L. Pearson, Daryl M. Chapin, and Calvin S. Fuller) receive patent US2780765, "Solar Energy Converting Apparatus." They refer to it as the "solar battery." Hoffman Electronics creates an 8% efficient solar cell.
- 1957 – Mohamed M. Atalla develops the process of silicon surface passivation by thermal oxidation at Bell Laboratories. The surface passivation process has since been critical to solar cell efficiency.
- 1958 - T. Mandelkorn, U.S. Signal Corps Laboratories, creates n-on-p silicon solar cells, which are more resistant to radiation damage and are better suited for space. Hoffman Electronics creates 9% efficient solar cells. Vanguard I, the first solar powered satellite, was launched with a 0.1W, 100 cm² solar panel.
- 1959 - Hoffman Electronics creates a 10% efficient commercial solar cell, and introduces the use of a grid contact, reducing the cell's resistance.

1960–1979

- 1960 - Hoffman Electronics creates a 14% efficient solar cell.
- 1962 - The Telstar communications satellite is powered by solar cells.
- 1963 - Sharp Corporation produces a viable photovoltaic module of silicon solar cells.
- 1964 - The satellite Nimbus I is equipped with Sun-tracking solar panels.

1967 - Soyuz 1 is the first manned spacecraft to be powered by solar cells

1967 - Akira Fujishima discovers the Honda-Fujishima effect which is used for hydrolysis in the photoelectrochemical cell.

1968 - Roger Riehl introduces the first solar powered wristwatch.

1970 - First highly effective GaAs heterostructure solar cells are created by Zhores Alferov and his team in the USSR.

1971 - Salyut 1 is powered by solar cells.

1973 - Skylab is powered by solar cells.

1974 - Florida Solar Energy Center begins.

1974 - J. Baldwin, at Integrated Living Systems, co-develops the world's first building (in New Mexico) heated and otherwise powered by solar and wind power exclusively.

1976 - David Carlson and Christopher Wronski of RCA Laboratories create first amorphous silicon PV cells, which have an efficiency of 2.4%.

1977 - The Solar Energy Research Institute is established at Golden, Colorado.

1977 - The world production of photovoltaic cells exceeded 500 kW

1978 - First solar-powered calculators.

Late 1970s: the "Energy Crisis"; groundswell of public interest in solar energy use: photovoltaic and active and passive solar, including in architecture and off-grid buildings and home sites.

1980–1999

1980 - John Perlin and Ken Butti's landmark book *A Golden Thread* published, covering 2500 Years of Solar Technology from the Greeks and Romans until the modern day

1980 - The Institute of Energy Conversion at University of Delaware develops the first thin film solar cell exceeding 10% efficiency using Cu2S/CdS technology.

1981 - Isofoton is the first company to mass-produce bifacial solar cells based on developments by Antonio Luque *et al.* at the Institute of Solar Energy in Madrid.

1982 - Kyocera Corp is the first manufacturer in the world to mass-produce Polysilicon solar cells using the casting method, today's industry standard.

1983 - Worldwide photovoltaic production exceeds 21.3 megawatts, and sales exceed $250 million.
- 1984 - 30,000 SF Building-Integrated Photovoltaic [BI-PV] Roof completed for the Intercultural Center of Georgetown University. Eileen M. Smith, M.Arch. took 20th Anniversary Journey by Horseback for Peace and Photovoltaics in 2004 from solar roof to Ground Zero NY World Trade Center to educate public about BI-PV Solar Architecture. Array was still generating an average of one MWh daily as it has since 1984 in the dense urban environment of Washington, DC.

- 1985 - 20% efficient silicon cells are created by the Centre for Photovoltaic Engineering at the University of New South Wales.


- 1988 - The Dye-sensitized solar cell is created by Michael Grätzel and Brian O'Regan (chemist). These photoelectrochemical cells work from an organic dye compound inside the cell and cost half as much as silicon solar cells.


- 1989 - Reflective solar concentrators are first used with solar cells.

- 1990 - The Magdeburg Cathedral installs solar cells on the roof, marking the first installation on a church in East Germany.

- 1991 - Efficient Photoelectrochemical cells are developed


- 1992 - The PV Pioneer Program started at Sacramento Municipal Utility District (SMUD). It was the first broad based commercialization of distributed, grid-connected PV system ("roof-top solar").

- 1992 - University of South Florida fabricates a 15.89% efficient thin-film cell

- 1993 - The National Renewable Energy Laboratory's Solar Energy Research Facility is established.

- 1994 - NREL develops a GaInP/GaAs two-terminal concentrator cell (180 suns) which becomes the first solar cell to exceed 30% conversion efficiency.

- 1996 - The National Center for Photovoltaics is established. Graetzel, École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland achieves 11% efficient energy conversion with dye-sensitized cells that use a photoelectrochemical effect.

- 1999 - Total worldwide installed photovoltaic power reaches 1,000 megawatts.
2003 - George Bush has a 9 kW PV system and a solar thermal systems installed on grounds keeping building at the White House


2004 - Kansas Governor Kathleen Sebelius issued a mandate for 1,000 MWp renewable electricity in Kansas by 2015 per Executive Order 04-05.

2006 - Polysilicon use in photovoltaics exceeds all other polysilicon use for the first time.

2006 - California Public Utilities Commission approved the California Solar Initiative (CSI), a comprehensive $2.8 billion program that provides incentives toward solar development over 11 years.


2007 - The Vatican announced that in order to conserve Earth's resources they would be installing solar panels on some buildings, in "a comprehensive energy project that will pay for itself in a few years."

2007 - University of Delaware claims to achieve new world record in Solar Cell Technology without independent confirmation - 42.8% efficiency.

2007 - Nanosolar ships the first commercial printed CIGS, claiming that they will eventually ship for less than $1/watt. However, the company does not publicly disclose the technical specifications or current selling price of the modules.

2008 - New record achieved in solar cell efficiency. Scientists at the U.S. Department of Energy's National Renewable Energy Laboratory (NREL) have set a world record in solar cell efficiency with a photovoltaic device that converts 40.8% of the light that hits it into electricity. However, it was only under the concentrated energy of 326 suns that this was achieved. The inverted metamorphic triple-junction solar cell was designed, fabricated and independently measured at NREL.

2010 - US President Barack Obama orders installation of additional solar panels and a solar water heater at the White House

2011 - Fast-growing factories in China push manufacturing costs down to about $1.25 per watt for silicon photovoltaic modules. Installations double worldwide.

2013 - After three years, the solar panels ordered by President Barack Obama were installed on the White House.

2016 - University of New South Wales engineers established a new world record for unfocused sunlight conversion to electricity with an efficiency increase to 34.5%. The record was set by UNSW’s Australian
Centre for Advanced Photovoltaics (ACAP) using a 28 cm² four-junction mini-module – embedded in a prism – that extracts the maximum energy from sunlight. It does this by splitting the incoming rays into four bands, using a four-junction receiver to squeeze even more electricity from each beam of sunlight.

- **2016** - First Solar says it has converted 22.1 percent of the energy in sunlight into electricity using experimental cells made from cadmium telluride—a technology that today represents around 5 percent of the worldwide solar power market.

- **2018** - Alta Devices, a US-based specialty gallium arsenide (GaAs) PV manufacturer, claimed to have achieved a solar cell conversion efficiency record of 29.1%, as certified by Germany's Fraunhofer ISE CalLab.

**Timeline of steam power**

**Early examples**

- **1st century AD** – Hero of Alexandria describes the Aeolipile, as an example of the power of heated air or water. The device consists of a rotating ball spun by steam jets; it produced little power and had no practical application, but is nevertheless the first known device moved by steam pressure. He also describes a way of transferring water from one vessel to another using pressure. The methods involved filling a bucket, the weight of which worked tackle to open temple doors, which were then closed again by a deadweight once the water in the bucket had been drawn out by a vacuum caused by cooling of the initial vessel.

- **1125**: In Reims, according to William of Malmesbury, an organ was powered by heated water. He claims it was built by Pope Sylvester II.

- **Late 15th century AD**: Leonardo Da Vinci described the Architonnerre, a steam-powered cannon.

- **1551**: Taqi al-Din Muhammad ibn Ma'ruf describes a steam turbine-like device for rotating a spit.

- **1601**: Giovanni Battista della Porta performs experiments on using steam to create pressure or a vacuum, building simple fountains similar to a percolator.

- **1606**: Jerónimo de Ayanz y Beaumont receives a patent for a steam-powered device for pumping water out of mines.

- **1615**: Salomon de Caus, who had been an engineer and architect under Louis XIII, publishes a book showing a device similar to that of Porta.

- **1629**: Giovanni Branca suggests using a steam turbine device similar to that described by Taqi al-Din but intended to be used to power a series of pestles working in mortars.

- **1630**: David Ramsay is granted a patent for various steam applications, although no description is given and the patent also covers a number of unrelated inventions. He refers to a "fire engine", and this term is used for many years.
Development of a practical steam engine

- 1663: Edward Somerset, 2nd Marquis of Worcester, publishes a selection of his inventions. One is a new sort of steam pump, essentially two devices like de Caus', but attached to a single boiler. A key invention is the addition of cooling around the containers to force the steam to condense. This produces a partial vacuum inside the chambers, which is used to draw a volume of water into the containers through a pipe, thus forming a pump. He builds one of very large size into the side of Raglan Castle, apparently the first "industrial scale" steam engine. He has plans to build them for mining, but dies before he can set up his company.

- 1680: Christiaan Huygens publishes memoirs describing a gunpowder engine that drives a piston. It is historically notable as the first known description of a piston engine.

- 1698: Thomas Savery introduces a steam pump he calls the Miner's Friend. It is almost certainly a direct copy of Somerset's design. One key improvement is added later, replacing the cold water flow on the outside of the cylinder with a spray directly inside it. A small number of his pumps are built, mostly experimental in nature, but like any system based on suction to lift the water, they have a maximum height of 32 feet (and typically much less). In order to be practical, his design can also use the pressure of additional steam to force the water out the top of the cylinder, allowing the pumps to be "stacked", but many mine owners were afraid of the high risk of explosion and avoided this option. (Savery engines were re-introduced in the 1780s to recirculate water to water wheels driving textile mills, especially in periods of drought).

- c. 1705: Thomas Newcomen develops the atmospheric engine, which, unlike the Savery pump, employs a piston in a cylinder; the vacuum pulling the piston down to the bottom of the cylinder when water is injected into it. The engine enabled a great increase in pumping height and the draining of deeper mines than possible when using vacuum to pull the water up. Savery holds a patent covering all imagined uses of steam power, so Newcomen and his partner John Calley persuade Savery to join forces with them to exploit their invention until the expiration of the patent in 1733.

- 1707: Denis Papin publishes a study on steam power, including a number of ideas. One uses a Savery-like engine to lift water onto a water wheel for rotary power. The study also proposes replacing the water of a Savery engine with a piston, which is pulled on by the vacuum in a cylinder after steam inside is condensed, but he was unable to build the device.

- 1718: Jean Desaguliers introduces an improved version of the Savery engine, which includes safety valves and a two-way valve that operated both the steam and cold water (as opposed to two separate valves). It is not commercially employed.

The Newcomen Engine: Steam power in practice

- 1712: Newcomen installs his first commercial engine.
• 1713: Humphrey Potter, a boy charged with operating a Newcomen engine, installs a simple system to automatically open and close the operating valves. The engine can now be run at 15 strokes a minute with little work other than firing the boiler.

• 1718: Henry Beighton introduces an improved and much more reliable version of Potter's operating system.

• 1720: Leupold designs an engine based on expansion, which he attributes to Papin, in which two cylinders alternately receive steam and then vent to the atmosphere. Although likely a useful design, it appears none were built.

• 1733: Newcomen's patent expires. By this time about 100 Newcomen engines have been built. Over the next 50 years engines are installed in collieries and metal mines all over England, notably in Cornwall, and are also used for municipal water supply and pumping water over water wheels, especially in ironworks.

• 1755: Josiah Hornblower installs the first commercial Newcomen engine in the USA, at the Schuyler Copper Mine in what is now North Arlington in Bergen County, New Jersey, using parts imported from the UK.

• 1769: John Smeaton experiments with Newcomen engines, and also starts building improved engines with much longer piston stroke than previous practice. Later engines, which marked probably the high point of Newcomen engine design, deliver up to 80 horsepower (around 60 kW).

• 1775: By this date about 600 Newcomen engines erected in the UK.

• 1779: The crank first applied by James Pickard to a Newcomen engine, producing rotary motion. Pickard patents this the following year, but the patent is unenforcable.

• 1780: Newcomen engines continue to be built in large numbers (about a thousand between 1775 and 1800), especially for mines but increasingly in mills and factories. Many have Watt condensers added after the patent expires (see below). Several dozen improved Savery engines are also built.

**Watt's engine**

• 1765: James Watt invents the separate condenser, the key being to relocate the water jet, (which condenses the steam and creates the vacuum in the Newcomen engine) inside an additional cylindrical vessel of smaller size enclosed in a water bath; the still-warm condensate is then evacuated into a hot well by means of a suction pump allowing the preheated water to be returned to the boiler. This greatly increases thermal efficiency by ensuring that the main cylinder can be kept hot at all times, unlike in the Newcomen engines where the condensing water spray cooled the cylinder at each stroke. Watt also seals the top of the cylinder so that steam at a pressure marginally above that of the atmosphere can act on top of the piston against the vacuum created beneath it.

• 1765: Matthew Boulton opens the Soho Manufactory engineering works in Handsworth.
• 1765: Ivan Polzunov builds a two-cylinder Newcomen engine for powering mine ventilation in Barnaul, Russia. It includes an automated system for governing the water level in the boiler.

• 1769: James Watt is granted a patent on his improved design. He is unable to find someone to accurately bore the cylinder and is forced to use a hammered iron cylinder. The engine performed poorly, due to the cylinder being out of round, allowing leakage past the piston. However, the increase in efficiency is enough for Watt and his partner Matthew Boulton to license the design based on the savings in coal per year, as opposed to a fixed fee. It would take Watt ten years in total to get an accurately bored cylinder.

• 1774: John Wilkinson invents a boring machine capable of boring precise cylinders. The boring bar goes completely through the cylinder and is supported on both ends, unlike earlier cantilevered boring tools. Boulton in 1776 writes that "Mr. Wilkinson has bored us several cylinders almost without error; that of 50 inches diameter, which we have put up at Tipton, does not err on the thickness of an old shilling in any part".

• 1775: Watt and Boulton enter into a formal partnership. Watt's patent is extended by Act of Parliament for 25 years until 1800.

• 1776: First commercial Boulton and Watt engine built. At this stage and until 1795 B&W only provided designs and plans, the most complicated engine parts, and support with on-site erection.

• 1781: Jonathan Hornblower patents a two-cylinder "compound" engine, in which the steam pushes on one piston (as opposed to pulling via vacuum as in previous designs), and when it reaches the end of its stroke is transferred into a second cylinder that exhausts into a condenser as "normal". Hornblower's design is more efficient than Watt's single-acting designs, but similar enough to his double-acting system that Boulton and Watt are able to have the patent overturned by the courts in 1799.

• 1782: First Watt rotative engine, driving a flywheel by means of the sun and planet gear rather than a crank, thus avoiding James Pickard's patent. Watt secures further patents in this year and 1784.

• 1783: Watt builds his first "double acting" engine, which admits steam so as to alternately act on one side of the piston then on the other, and the introduction of his parallel motion linkage allows the transmission of the power of the piston motion to be transmitted to the beam on both strokes. This change enables use of a flywheel imparting steady rotary motion controlled by a governor, thus making it possible for the engine to drive machinery in non speed critical applications like milling, breweries and other manufacturing industries. Because the centrifugal governor alone had poor response to load changes, Watt's engine was not suitable for cotton spinning.

• 1784: William Murdoch demonstrates a model steam carriage working on "strong steam". He is dissuaded from patenting his invention by his employer, James Watt.

• 1788: Watt builds the first steam engine to use a centrifugal governor for the Boulton & Watt Soho factory.

• 1790: Nathan Read invented the tubular boiler and improved cylinder, devising the high-pressure steam engine.
• 1791: Edward Bull makes a seemingly obvious design change by inverting the steam engine directly above the mine pumps, eliminating the large beam used since Newcomen's designs. About 10 of his engines are built in Cornwall.

• 1795: Boulton and Watt open their Soho Foundry, for the manufacture of steam engines

• 1799: Richard Trevithick builds his first high-pressure engine at Dolcoath tin mine in Cornwall.

• 1800: Watt's patent expires. By this time about 450 Watt engines (totaling 7,500 hp) and over 1500 Newcomen engines have been built in the UK.

**Improving power**

• 1801: Richard Trevithick builds and runs Camborne road engine.

• 1801: Oliver Evans builds his first high-pressure steam engine in the U.S. (Ptd. 1804)

• 1804: Richard Trevithick builds and runs single-cylinder flywheel locomotive on the 9-mile Pen-y-Darran tramway. Due to plate breakages the engine is installed at Dowlais for stationary use.

• 1804: John Steel builds locomotive to Trevithick's model at Gateshead for Mr Smith. This is demonstrated to Christopher Blackett who refuses it for reasons of excess weight.

• 1804: Arthur Woolf re-introduces Hornblower's double-cylinder designs now that Watt's patents have expired. He goes on to build a number of examples with up to nine cylinders as boiler pressures increase through better manufacturing and materials.

• 1808: Christopher Blackett relays track at Wylam Colliery.

• 1808: Richard Trevithick demonstrates the passenger carrying railway with his "steam circus" (using the locomotive *Catch Me Who Can* on a circular track) in London.

• 1811: Blackett employs Thomas Waters to build a new flywheel locomotive.

• 1811: Blackett instructs Timothy Hackworth to build hand-cranked chassis to prove feasibility of smooth rail for traction.

• 1811: Second Wylam locomotive built by Blackett's development team consisting of Timothy Hackworth, William Hedley, and Jonathan Foster.

• 1812: Blenkinsop develops rack railway system in collaboration with Matthew Murray of Leeds Round Foundry - single-flue boiler; vertical cylinders sunk into boiler.

• 1813: Third Wylam locomotive built, with 8 wheels to spread axle load.

• 1815: George Stephenson builds *Blücher* - similar to Blenkinsop model.

• 1825: Robert Stephenson & Co build *Locomotion* for Stockton and Darlington Railway.

• 1827: Timothy Hackworth builds highly efficient *Royal George* with centrally-placed blastpipe in the chimney for Stockton and Darlington Railway.
• 1829: Robert Stephenson & Co successfully competes at Rainhill Trials with *The Rocket* against Hackworth's *Sans Pareil* and Braithwaite's and Ericsson's *Novelty*.

• 1830: *Stephensonian* locomotive configuration appears with Stephenson's *Planet* type along with Edward Bury's *Liverpool* - horizontal cylinders placed beneath smokebox; drive to rear crank - bar frames. Liverpool Manchester Line opens with tumultuous acclaim.

• 1849: George Henry Corliss develops and markets the Corliss-type steam engine, a four-valve counterflow engine with separate steam admission and exhaust valves. Trip valve mechanisms provide sharp cutoff of steam during admission stroke. The governor is used to control the cut off instead of the throttle valve. The efficiency of Corliss engines greatly exceeds other engines of the period, and they are rapidly adopted in stationary service throughout industry. The Corliss engine has better response to changes in load and runs at a more constant speed, making it suitable for applications such as thread spinning.

• 1854: John Ramsbottom publishes a report on his use of oversized split steel piston rings which maintain a seal by outward spring tension on the cylinder wall. This allows much better sealing (compared to earlier cotton seals) which leads to significantly higher system pressures before "blow-by" is experienced.

• 1862: The Allen steam engine (later called Porter-Allen) is exhibited at the London Exhibition. It is precision engineered and balanced allowing it to operate at from three to five times the speed of other stationary engines. The short stroke and high speed minimize condensation in the cylinder, significantly improving efficiency. The high speed allows direct coupling or the use of reduced sized pulleys and belting.

• 1862: The steam engine indicator is exhibited at the London Exhibition. Developed for Charles Porter by Charles Richard, the steam engine indicator traces on paper the pressure in the cylinder throughout the cycle, which can be used to spot various problems and to optimize efficiency. Earlier versions of the steam engine indicator were in use by 1851, though relatively unknown.

• 1865: Auguste Mouchout invents the first device to convert solar energy into mechanical steam power, using a cauldron filled with water enclosed in glass, which would be put in the sun to boil the water.

• 1867: Stephen Wilcox and his partner George Herman Babcock patent the "Babcock & Wilcox Non-Explosive Boiler", which uses water inside clusters of tubing to generate steam, typically with higher pressures and more efficiently than the typical "firetube" boilers of that time. Babcock & Wilcox-type boiler designs become popular in new installations.

• 1881: Alexander C. Kirk designs the first practical triple expansion engine which was installed in SS *Aberdeen*.

• 1884: Charles Algernon Parsons develops the steam turbine. Used early on in electrical generation and to power ships, turbines were bladed wheels that created rotary motion when high pressure steam was passed through them. The efficiency of large steam turbines was considerably better than the best compound
engines, while also being much simpler, more reliable, smaller and lighter all at the same time. Steam turbines would eventually replaced piston engines for most power generation.

- 1893: Nikola Tesla patents a steam powered oscillating electro-mechanical generator. Tesla hoped it would become competitive with steam turbines in producing electric current but it never found use outside his laboratory experiments.

- 1897: Stanley Brothers begin selling lightweight steam cars, over 200 being made.

- 1899: The Locomobile Company begins manufacture of the first production steam-powered cars, after purchasing manufacturing rights from the Stanley Brothers.

- 1902: The Stanley Motor Carriage Company begins manufacture of the Stanley Steamer, the most popular production steam-powered car.

- 1903: Commonwealth Edison Fisk Generating Station opens in Chicago, using 32 Babcock & Wilcox boilers driving several GE Curtis turbines, at 5000 and 9000 kilowatts each, the largest turbine-generators in the world at that time. Almost all electric power generation, from the time of the Fisk Station to the present, is based on steam driven turbine-generators.

- 1913: Nikola Tesla patents a bladeless steam turbine that utilizes the boundary layer effect. This design has never been used commercially due to its low efficiency.

- 1923: Alan Arnold Griffith publishes An Aerodynamic Theory of Turbine Design, describing a way to dramatically improve the efficiency of all turbines. In addition to making newer power plants more economical, it also provides enough efficiency to build a jet engine.

- 1933: George and William Besler of the United States are the first aviators (and to this date only aviators) to successfully fly on steam power on April 12, 1933 with a converted Travel Air 2000 biplane, using a 90° V-twin compound engine of their own design.


- 2009: On August 26, 2009, Team Inspiration broke a second record by setting a new speed record of 148.308 mph (238.679 km/h) over a measured kilometer.

Timeline of women's education
13th century

1237

- Italy: Bettisia Gozzadini earns a law degree at the University of Bologna.

1239

- Italy: Bettisia Gozzadini teaches Law at the University of Bologna. First woman believed to teach at a university (first university established in 1088).

14th century

- Italy: Dorotea Bucca holds a chair of medicine and philosophy in the University of Bologna for 40 years from 1390.
- Italy: Novella d'Andrea teaches Law at the University of Bologna.

16th century

- Spain: Luisa de Medrano teaches at the University of Salamanca and writes works of philosophy, now lost.
- Spain: Isabella Losa gets a D.D. (Doctor of Divinity) theology degree.
- Spain: Francisca de Lebrija teaches rhetorics at a University of Alcala.
- Spain: Beatriz Galindo excels in Latin, studies at one of the institutions dependent on the University of Salamanca, writes commentary on Aristotle and becomes a teacher of the queen.

17th century

1608

- Spain: Juliana Morell, a Spanish woman, earns a Law doctorate degree. According to Lope de Vega, she taught "all the sciences from professorial chairs".

1636

- Netherlands: German-born Dutch Anna Maria van Schurman, proficient in 14 languages, studied as the first female student at the university of Utrecht, Netherlands, but without obtaining a degree.
1639

- Acadia: The French colony of Acadia, which at the time included part of Maine, had an Ursuline boarding school by 1639 that was geared toward the education of young girls. The school was founded in Quebec City and is still in operation today, though this part of Canada no longer includes the part of Maine that it once did.

1644

- Sweden: first female college students, Ursula Agricola and Maria Jonae Palmgren.

1674

- New Spain: In this year Bishop Calderon of Santiago wrote to Queen Mother Marie Anne of Spain concerning the Spanish efforts at colonizing Florida. In his letter he included some comments about the state of education and stated, "The children, both male and female, go to church on work days, to a religious school where they are taught by a teacher whom they call *Athequi* of the church; [a person] whom the priests have for this service." This description indicates that the colonies of New Spain had facilities for female education at least by the 1600s. It is not clear how far back this goes; the 1512 laws of Burgos, from over a hundred years earlier, did not specify whether instruction should be for males only: it uses the word *hijos*, which means sons, but can include daughters if they are mixed in with the boys.

1678

- Italy: Elena Cornaro Piscopia, an Italian woman, earns a Ph.D. – Philosophy doctorate degree from the University of Padua in Italy and is said to have taught mathematics at the University of Padua.

1685

- Italy: Rosa Venerini opens the first free school for girls in Italy, in the town of Viterbe.

18th century

1727

- United States: Founded in 1727 by the Sisters of the Order of Saint Ursula, Ursuline Academy, New Orleans, is both the oldest continuously operating school for girls and the oldest Catholic school in the United States. The Ursuline Sisters founded this school out of the conviction that the education of women
was essential to the development of a civilized, spiritual and just society, and has influenced culture and learning in New Orleans by providing an exceptional education for its women.

1732

- Italy: Laura Bassi, an Italian woman, earned a Ph.D. degree at the University of Bologna in Italy, and taught physics at the same university.

1742

- United States: At only 16 years of age, Countess Benigna von Zinzendorf established the first all-girls boarding school in America, sponsored by her father Count Nicholas von Zinzendorf. Originally known as the Bethlehem Female Seminary upon its 1742 founding, it changed its name to Moravian Seminary and College for Women by 1913. 1863 proved the Germantown, Pennsylvania-based school’s most landmark year, however, when the state recognized it as a college and granted it permission to reward bachelor’s degrees. As a result, most tend to accept Moravian as the oldest—though not continuously operational because of its current co-ed status—specifically female institute of higher learning in the United States.

1751

- Italy: Cristina Roccati became the third woman to receive a Ph.D. degree in Italy, and taught physics at the Academia.

1783

- United States: Washington College in Chestertown, Maryland, appointed the first women instructors at any American college or university, Elizabeth Callister Peale and Sarah Callister – members of the famous Peale family of artists – taught painting and drawing.

1786

- Russia: Catherine the Great opened free public primary and high school education to girls.

1787

- Germany: Dorothea Schlözer became the first German woman to earn a PhD from Georg-August Universität Göttingen.
• Sweden: Aurora Liljenroth became the first female college graduate.

19th century

1800–1849

1803

• United States: Bradford Academy in Bradford, Massachusetts was the first higher educational institution to admit women in Massachusetts. It was founded as a co-educational institution, but became exclusively for women in 1837.

1818

• India: Western Christian missionaries opened the first schools in India open to girls.

1822

• Serbia: Girls were allowed to attend elementary schools with boys up until the fourth grade.

1823

• Argentina: the Sociedad de Beneficencia de Buenos Aires was charged by the government to establish and control (private) elementary schools for girls (they retain the control of the schools for girls until 1876).

1826

• United States: The first American public high schools for girls were opened in New York and Boston.

1827

• Brazil: the first elementary schools for girls and the profession of school teacher were opened.

1829

• United States: The first public examination of an American girl in geometry was held.

1830s

• Egypt: In Egypt Christian missionaries were allowed to open elementary schools for girls.
1831

- United States: As a private institution in 1831, Mississippi College became the first coeducational college in the United States to grant a degree to a woman. In December 1831 it granted degrees to two women, Alice Robinson and Catherine Hall.

1834

- Greece: Greece got compulsory primary education for both boys and girls, in parallel with the foundation of the first private secondary educational schools for girls such as the Arsakeio.

1834

- Iran: The first modern school for girls was opened in Iran, Urmia.

1837

- United States: Bradford Academy in Bradford, Massachusetts, due to declining enrollment, became a single-sexed institution for the education of women exclusively.

1839

- United States: Established in 1836, Georgia Female College in Macon, GA opened its doors to students on January 7, 1839. Now known as Wesleyan College, it was the first college in the world chartered specifically to grant bachelor’s degrees to women.

1841

- Bulgaria: In Bulgaria the first secular girls school made education and the profession of teacher available for women.

1842

- Sweden: Sweden requires compulsory Elementary school for both sexes.

1843

- Ghana: Catherine Mulgrave arrived on the Gold Coast from Jamaica and subsequently established three boarding schools for girls at Osu (1843), Abokobi (1855) and Odumase (1859) between 1843 and 1891.
1844
- Finland: The foundation of the Svenska fruntimmersskolan i Åbo and its sister school Svenska fruntimmersskolan i Helsingfors in Helsinki.

1846
- Denmark: The foundation of the Den højere Dannelsesanstalt for Damer, the first college for women in Denmark.

1847
- Belgium: elementary school for both genders
- Costa Rica: first high school for girls, and the profession of teacher was opened to women.
- Ghana: Rosina Widmann opens vocational school for girls in January 1847, with the first classes in needlework for 12 girls at her home in Akropong in the Gold Coast colony

1849
- United States: Elizabeth Blackwell, born in England, became the first woman to earn a medical degree from an American college, Geneva Medical College in New York.
- United Kingdom: Bedford College opens in London as the first higher education college for women in the United Kingdom.
- India: Secondary education for girls was made available by the foundation of the Bethune School.

1850–1874

1850
- United States: Lucy Sessions earned a literary degree from Oberlin College, becoming the first black woman in the United States to receive a college degree.
- France: Elementary education for both sexes, but girls were only allowed to be tutored by teachers from the church.
- Haiti: First permanent school for girls. the l’Institution Mont-Carmel of Marie-Rose Léodille Delaunay.

1851
- Ghana: Regina Hesse moved into the household of her mentor, Catherine Mulgrave and her spouse, Johannes Zimmermann to understudy the methods of pedagogy. She later became the de facto principal of Mulgrave's girls' school at Christiansborg.

1852

- Nicaragua: Josefa Vega are granted dispensation to attend lectures at university, after which women are given the right to apply for permission to attend lectures at university (though not to an actual full university education).

1853

- Egypt: The first Egyptian school for females was opened by the Copts minority.
- Serbia: The first secondary educational school for females was inaugurated (public schools for girls having opened in 1845–46).
- Sweden: The profession of teacher at public primary and elementary schools was opened to both sexes.

1854

- Chile: First public elementary school for girls.

1855

- United States: University of Iowa becomes the first coeducational public or state university in the United States.

1857

- Netherlands: Elementary education compulsory for both girls and boys.
- Spain: Elementary education compulsory for both girls and boys.

1858

- United States: Mary Fellows became the first woman west of the Mississippi River to receive a baccalaureate degree.
- Ottoman Empire: The first state school for girls is opened; several other schools for girls are opened during the following decades.
- Russia: gymnasiums for girls.
1859

- Denmark: The post of teacher at public schools are opened to women.
- Ghana: Rose Ann Miller started an all-girls' boarding school at Aburi under the auspices of the Basel Mission.
- Sweden: The post of college teacher and lower official at public institutions are open to women.

1860

- Norway: Women are allowed to teach in the rural elementary school system (in the city schools in 1869).

1861

- Sweden: The first public institution of higher academic learning for women, Högre lärarinneseminariet, is opened.

1862

- United States: Mary Jane Patterson became the first African-American woman to earn a BA in 1862. She earned her degree from Oberlin College.

1863

- Serbia: The inauguration of the Women's High School in Belgrade, first high school open to women in Serbia (and the entire Balkans).
- United States: Mary Corinna Putnam Jacobi graduated from the New York College of Pharmacy in 1863, which made her the first woman to graduate from a United States school of pharmacy.

1864

- United States: Rebecca Crumpler became the first African-American woman to graduate from a U.S. college with a medical degree and the first and only black woman to obtain the Doctress of Medicine degree from New England Female Medical College in Boston, MA.
- Belgium: The first official secondary education school open to females in Belgium.
- Haiti: Elementary schools for girls are founded.

1865
• Romania: The educational reform granted all Romanians access to education, which, at least formally, gave also females the right to attend school from elementary education to the university.

1866
• United States: Lucy Hobbs Taylor became the first American woman to earn a dental degree, which she earned from the Ohio College of Dental Surgery.

1866
• United States: Sarah Jane Woodson Early became the first African-American woman to serve as a professor. Xenia, Ohio’s Wilberforce University hired her to teach Latin and English in 1866.

1867
• Switzerland: University of Zurich formally open to women, though they had already been allowed to attend lectures a few years prior.

1868
• Croatia: The first high school open to females.

1869
• United States: Fanny Jackson Coppin was named principal of the Institute for Colored Youth in Philadelphia, becoming the first black woman to head an institution for higher learning in the United States.
• Austria-Hungary: The profession of public school teacher is open to women.
• Costa Rica: Elementary education compulsory for both girls and boys.
• Ottoman Empire: The law formally introduce compulsory elementary education for both boys and girls.
• Russia: University Courses for women are opened, which opens the profession of teacher, law assistant and similar lower academic professions for women (in 1876, the courses are no longer allowed to give exams, and in 1883, all outside of the capital is closed).
• United Kingdom: Watt Institution and School of Arts, a predecessor of Heriot-Watt University, admits women. Mary Burton persuaded the Watt Institution and School of Arts to open its doors to women students in 1869 and went on to become the first woman on the School’s Board of Directors and a life Governor of Heriot-Watt College. One of the first women to serve on Edinburgh Parochial and School Boards, Mary was a lifelong campaigner for women’s suffrage and an advocate for educational opportunities for all.
• United Kingdom: The Edinburgh Seven were the first group of matriculated undergraduate female students at any British university. They began studying medicine at the University of Edinburgh in 1869 and although they were unsuccessful in their struggle to graduate and qualify as doctors, the campaign they fought gained national attention and won them many supporters including Charles Darwin. It put the rights of women to a University education on the national political agenda which eventually resulted in legislation to ensure that women could study at University in 1877.

• United Kingdom: Girton College opens as the first residential college for women in the United Kingdom.

1870:

• United States: The first woman is admitted to Cornell.
• United States: The Board of Regents of the University of California ruled that women should be admitted on an equal basis with men. With the completion of North and South Halls in 1873, the university relocated to its Berkeley location with 167 male and 22 female students.
• Finland: Women allowed to study at the universities by dispensation (dispensation demand dropped in 1901).
• United States: Ada Kepley became the first American woman to earn a law degree, from Northwestern University School of Law.
• United States: Ellen Swallow Richards became the first American woman to earn a degree in chemistry, which she earned from Vassar College in 1870.
• Ottoman Empire: The Teachers College for Girls are opened in Constantinople to educate women to professional teachers for girls school; the profession of teacher becomes accessible for women and education accessible to girls.
• Spain: The Asociación para la Enseñanza de la Mujer is founded: promoting education for women, it establishes secondary schools and training colleges all over Spain, which makes secondary and higher education open to females for the first time.
• Sweden: Universities open to women (at the same terms as men 1873). The first female student is Betty Pettersson.

1871

• Netherlands: Aletta Jacobs became the first female to get accepted at the University of Groningen.
• United States: Frances Elizabeth Willard became the first female college president in the United States, as president of Evanston College for Ladies in Illinois.
• India: First training school for woman teachers.
• Japan: Women are allowed to study in the USA (though not yet in Japan itself).
• New Zealand: Universities open to women.
• United States: Harriette Cooke became the first woman college professor in the United States appointed full professor with a salary equal to that of her male peers.

1872:
• Sweden: First female university student: Betty Pettersson.
• Japan: Compulsory elementary education for both girls and boys.
• Ottoman Empire: The first government primary school open to both genders. Women's Teacher's Training School opened in Istanbul.
• Spain: Maria Elena Maseras is allowed to enlist as a university student with special dispensation: having been formally admitted to a class in 1875, she was finally allowed to graduate 1882, which created a Precedent allowing females to enroll at universities from this point on.

1873:
• United States: Linda Richards became the first American woman to earn a degree in nursing.
• Egypt: The first public Egyptian primary school open to females: two years later, there are 32 primary schools for females in Egypt, three of whom also offered secondary education.

1874–1899

1874:
• United States: The first woman to graduate from the University of California, Rosa L. Scrivner, obtained a Ph.B in Agriculture.
• Iran: The first school for girls is founded by American missionaries (only non-Muslims attend until 1891).
• Japan: The profession of public school teacher is opened to women.
• Netherlands: Aletta Jacobs becomes the first woman allowed to study medicine.
• United Kingdom: London School of Medicine for Women founded, the first medical school in Britain to train women.
• Germany: Russian mathematician Sofia Kovalevskaya became the first woman in modern Europe to gain a doctorate in mathematics, which she earned from the University of Göttingen in Germany.
• Canada: Grace Lockhart became the first woman in the British Empire to receive a Bachelor's degree, graduating from Mount Allison University in Canada.
1875:

- Switzerland: Stefania Wolicka-Arnd, a Polish woman, became the first woman to earn a PhD from the University of Zurich in Switzerland.
- Denmark: Universities open to women.
- India: First women admitted to college courses, although with special permission (at Madras Medical College).

1876:

- Argentina: Girls are included in the national school system by the transference of the control of the private girls schools from the charitable Beneficent Society to the provincial government.
- Great Britain: Medical examining bodies given the right to certify women.
- India: Women allowed to attend university exams at the Calcutta University.
- Italy: Universities open to women.
- Netherlands: Universities open to women.
- United States: Anna Oliver was the first woman to receive a Bachelor of Divinity degree from an American seminary (Boston University School of Theology).

1877:

- United States: Helen Magill White became the first American woman to earn a Ph.D., which she earned at Boston University in the subject of Greek.
- Chile: Universities open to women.
- New Zealand: Kate Edger became the first women to graduate from a university in New Zealand.

1878:

- Austria-Hungary: Women allowed to attend university lectures as guest auditors.
- Bulgaria: Elementary education for both genders.
- Russia: The Bestuzhev Courses open in Saint Petersburg.
- United Kingdom: Lady Margaret Hall, the first college in the University of Oxford to admit women, is founded.
- United States: Mary L. Page became the first American woman to earn a degree in architecture, which she earned from the University of Illinois, Urbana-Champaign.
• United Kingdom: The University of London receives a supplemental charter allowing it to award degrees to women, the first university in the United Kingdom to open its degrees.

1879:

• United States: Mary Eliza Mahoney became the first African-American in the U.S. to earn a diploma in nursing, which she earned from the School of Nursing at the New England Hospital for Woman and Children in Boston.
• Brazil: Universities open to women.
• France: Colleges and secondary education open to women.
• India: The first college open to women: Bethune College (the first female graduate in 1883).

1880:

• United Kingdom: First four women gain BA degrees at the University of London, the first women in the UK to be awarded degrees.
• Australia: Universities open to women.
• Belgium: The University of Brussels opened to women.
• Canada: Universities open to women.
• France: Universities open to women.
• France: Free public secondary education to women.
• France: Public teachers training schools open to women.

1881:

• United Kingdom: Women were allowed to take the Cambridge Mathematical Tripos exams, after Charlotte Angas Scott was unofficially ranked as eighth wrangler.
• United States: American Association of University Women founded

1882:

• United Kingdom: College Hall opened by University College London and the London School of Medicine for Women as the first women's hall of residence in the UK.
• France: Compulsory elementary education for both genders.
• Norway: Women allowed to study at the university.
• Nicaragua: The first public secular education institution for women, Colegio de Señoritas, open.
- Poland: The Flying University provides academic education for women.
- Serbia: Compulsory education for both genders.
- Belgium: Universities open to women.
- India: Bombay University open to women.
- Romania: Universities open to women.

1883:
- Australia: Bella Guerin became the first woman to graduate from a university in Australia, graduating from the University of Melbourne in 1883.
- Sweden: Ellen Fries, First female Ph.D. promoted.
- United States: Susan Hayhurst became the first woman to receive a pharmacy degree in the United States, which she received from the Philadelphia College of Pharmacy.
- United Kingdom: Sophie Bryant becomes the first woman in Britain to earn a DSc.

1885:
- Sierra Leone: Adelaide Casely-Hayford became the first African woman study music at the Stuttgart Conservatory.

1886:
- United States: Winifred Edgerton Merrill became the first American woman to earn a PhD in mathematics, which she earned from Columbia University.
- France: Women eligible to join public education boards.
- Costa Rica: A public academic educational institution open to women.
- Korea: The first educational institution for women, Ewha Womans University is founded.
- Mexico: Universities open to women.
- United States: Anandibai Joshi from India, Keiko Okami from Japan, and Sabat Islambouli from Syria became the first women from their respective countries (and in Joshi's case the first Hindu woman) to get a degree in western medicine, which they each got from the Women’s Medical College of Pennsylvania (WMCP), where they were all students in 1885.
- France: Iulia Hasdeu was the first Romanian woman to study at the Sorbonne. She enrolled at age 16 and died two years later while preparing her doctoral thesis.

1887:
• Albania: The first Albanian language elementary school open to female pupils.

1889:

• United States: Maria Louise Baldwin became the first African-American female principal in Massachusetts and the Northeast, supervising white faculty and a predominantly white student body at the Agassiz Grammar School in Cambridge.
• United States: Susan La Flesche Picotte became the first Native American woman to earn a medical degree, which she earned from Woman's Medical College of Pennsylvania.
• Egypt: The first teacher training college for women.
• Argentina: Cecilia Grierson became the first woman in Argentina to earn a medical university degree.
• Palestine: The first school open to girls founded by missionaries.
• Sweden: Women eligible to join boards of public authority such as public school boards.
• Sweden: First female professor: Sofia Kovalevskaya.
• United Kingdom: Scottish universities opened to women by the Universities (Scotland) Act 1889.
• El Salvador: Antonia Navarro Huezo became the first Salvadoran woman to earn a topographic engineering doctorate.

1890:

• United States: Ida Gray became the first African-American woman to earn a Doctor of Dental Surgery degree, which she earned from the University of Michigan.
• Finland: Signe Hornborg graduates as an architect from the Helsinki University of Technology in Finland, becoming the first ever formally qualified female architect in the world.
• Bohemia: The first secondary education school for females in Prague.
• Greece: Universities open to women.

1891:

• Albania: The first school of higher education for women is opened. It was founded by siblings Sevasti Qiriazi and Gjerasim Qiriazi.
• Germany: Women are allowed to attend university lectures, which makes it possible for individual professors to accept female students if they wish.
• Portugal: The first medical university degree is granted to a woman.
• Switzerland: Secondary schools open to women.
1892:

- United States: Laura Eisenhuth became the first woman elected to state office as Superintendent of Public Instruction.

1893:

- Ottoman Empire: Women are permitted to attend medical lectures at Istanbul University.
- France: Dorothea Klumpke became the first woman to be awarded a doctorate in sciences.

1894:

- Poland: Kraków University open to women.
- United States: Margaret Floy Washburn became the first American woman to be officially awarded the PhD degree in psychology, which she earned at Cornell University under E. B. Titchener.

1895:

- Austria-Hungary: Universities open to women.
- Egypt: A public school system for girls is organized.

1896:

- Norway: Women are admitted at all secondary educational schools of the state.
- Spain: María Goyri de Menéndez Pidal became the Spanish first woman to earn a degree in philosophy and letters. She earned a licentiate from the University of Madrid.

1897:

- Switzerland: Anita Augspurg became the first German woman to receive a Doctor of Law, which earned at the University of Zurich, despite not being able to practice law in Germany until 1922.
- Austria-Hungary: Gabriele Possanner became the first woman to receive a medical degree and subsequently, the first practicing female doctor of the country.

1898:

- Haiti: The Medical University accept female students in obstetrics.
• Serbia: Co-education, banned since the 1850s, is re-introduced, equalizing the schooling of males and females.
• United Kingdom: Margaret Murray became the first woman lecturer of archaeology in the United Kingdom.

1899:
• Germany: Women are admitted to study medicine, dentistry and pharmacy.

20th century

1900–1939

1900:
• Egypt: A school for female teachers is founded in Cairo.
• United States: Otelia Cromwell became the first black woman to graduate from Smith College in Northampton, Massachusetts.
• Tunisia: The first public elementary school for girls.
• Japan: The first Women's University.
• Baden, Germany: Universities open to women.
• Sri Lanka: Secondary education open to females.

1901:
• Bulgaria: Universities open to women.
• Cuba: Universities open to women.

1902:
• Australia: Ada Evans became the first woman to graduate in law in Australia at the University of Sydney.

1903:
• United States: Mignon Nicholson became the first woman in North America to earn a veterinary degree, which she earned from McKillip Veterinary College in Chicago, Illinois.
Canada: Clara Benson and Emma Sophia Baker became the first women to earn a PhD from the University of Toronto.

Norway: Clara Holst became the first woman to earn a Ph.D. in Norway, which she earned from Royal Frederick University. Her dissertation was titled *Studier over middelnedertyske laaneord i dansk i det 14. og 15. aarhundrede* (English: Study of Middle Low German loanwords in Danish in the 14th and 15th centuries).

1904:

- United States: Helen Keller graduated from Radcliffe, becoming the first deafblind person to earn a Bachelor of Arts degree.
- United Kingdom: Millicent Mackenzie is appointed as Assistant Professor of Education at the University College of South Wales and Monmouthshire (part of the University of Wales), the first woman professor in the UK.
- Württemberg, Germany: Universities open to women.

1905:

- United States: Nora Stanton Blatch Barney, born in England, became the first woman to earn a degree in any type of engineering in the United States, which she earned from Cornell University. It was a degree in civil engineering.
- Argentina: University preparatory secondary education open to females.
- Iceland: Educational institutions open to women.
- Russia: Universities open to women.
- Serbia: Female university students are fully integrated in to the university system.
- Australia: Flos Greig became the first woman to be admitted as a barrister and solicitor in Australia, having graduated in 1903.

1906:

- Saxony, Germany: Universities open to women.

1907:

- China: Girls are included in the education system.
- Sudan: The first school open to Muslim girls.
- Iran: Compulsory primary education for females.
• Iran: The first Iranian school for girls is established by Tuba Azmudeh, followed by others in the following years.
• Japan: Tohoku University, the first (private) coeducational university.

1908:

• United States: Alpha Kappa Alpha Sorority, the first black Greek letter organization for woman, was founded at Howard University.
• United Kingdom: Edith Morley is appointed Professor of English Language at University College Reading, becoming the first full professor at a British university institute.
• Korea: Secondary education for females through the foundation of the Capital School for Girl's Higher Education.
• Peru: Universities open to women.
• Prussia, Alsace-Lorraine and Hesse, Germany: Universities open to women.
• Switzerland: The Russian-born Anna Tumarkin was the first female professor in Europe with the right to examine doctoral and post-doctoral students

1909:

• United States: Ella Flagg Young became the first female superintendent of a large city school system in the United States.
• Spain: Maria Goyri de Menéndez Pidal became the first woman to earn a Ph.D. in Spain, which she earned at the University of Madrid in the subject of philosophy and letters.

1910:

• United Kingdom: Millicent Mackenzie is promoted to full professor, the first woman to reach this level at a fully chartered university in the UK.

1911:

• Luxembourg: A new educational law gives women access to higher education, and two secondary education schools open to females.

1912:

• China: The Chinese government established secondary schools for young women.
• Costa Rica: Felicitas Chaverri Matamoros becomes the first female university student of the country in the Pharmacy School, in 1917 she becomes the first Costa Rican female university graduate.

• Japan: Tsuruko Haraguchi became the first Japanese woman to earn a Ph.D.

1913:

• United Kingdom: Caroline Spurgeon successfully competed for the newly created chair of English Literature at Bedford College, London, becoming the second female professor in England.

1914:

• Sierra Leone: Kathleen Mary Easmon Simango became the first West African woman to become an Associate of the Royal College of Art.

1915:

• United States: Lillian Gilbreth earned a PhD in industrial psychology from Brown University, which was the first degree ever granted in industrial psychology. Her dissertation was titled "Some Aspects of Eliminating Waste in Teaching".

1917:

• Greece: The first public secondary educational school for girls open.
• Iran: Public schools for girls are opened in order to enforce the law of compulsory education for girls in practice.
• Uruguay: University education open to women.
• Nicaragua: The first female obtains a university degree.

1918:

• Thailand: Universities open to women.

1920:

• Portugal: Secondary school open to women.
• China: The first female students are accepted in the Peking University, soon followed by universities all over China.
1921:

- United States: Sadie Tanner Mossell became the first African-American woman to earn a Ph.D. in the U.S. when she earned a Ph.D. in Economics from the University of Pennsylvania.
- Thailand: Compulsory elementary education for both girls and boys.

1922:

- United States: Sigma Gamma Rho Sorority was founded. It was the fourth black Greek letter organization for women, and the first black sorority established on a predominantly white campus, Butler University in Indianapolis, Indiana.

1923:

- Canada: Elsie MacGill graduated from the University of Toronto in 1927, and was the first Canadian woman to earn a degree in electrical engineering.
- Egypt: Compulsory education for both sexes.
- United States: Virginia Proctor Powell Florence became the first black woman in the United States to earn a degree in library science. She earned the degree (Bachelor of Library Science) from what is now part of the University of Pittsburgh.

1924

- Russia: Olga Freidenberg was the first woman in Russia to earn a Ph.D. in classical philology, which she earned from Petrograd University.

1925:

- Korea: Professional school for women (at Ewha Womans University).

1926:

- United States: Dr. May Edward Chinn became the first African-American woman to graduate from the University and Bellevue Hospital Medical College.

1927:

- Afghanistan: The monarch introduces compulsory education for the daughters of officials.
1928:

- Afghanistan: The first women are sent abroad to study (women banned from studying abroad in 1929).
- Bahrain: The first public primary school for girls.
- Egypt: The first women students are admitted to Cairo University.
- Ghana: Jane E. Clerk was one of two students in the first batch of Presbyterian Women’s Training College.

1929:

- Greece: Secondary education for females is made equal to that of males.
- Nigeria: Agnes Yewande Savage became the first West African woman to graduate from medical school, obtaining her degree at the University of Edinburgh.
- United States: Jenny Rosenthal Bramley, born in Moscow, became the first woman to earn a Ph.D. in physics in the United States, which she earned from New York University.
- United States: Elsie MacGill, from Canada, became the first woman in North America, and likely the world, to be awarded a master's degree in aeronautical engineering.

1930:

- Turkey: Equal right to university education for both men and women.

1931:

- United States: Jane Matilda Bolin was the first black woman to graduate from Yale Law School.
- United States: Bradford Academy, in Bradford, Massachusetts, changed name to Bradford Junior College and offered a two year degree for women.

1932:

- United States: Dorothy B. Porter became the first African-American woman to earn an advanced degree in library science (MLS) from Columbia University.

1933:

- Sierra Leone: Edna Elliott-Horton became the first West African woman to receive a baccalaureate degree in the liberals arts when she graduated from Howard University.
• United States: Inez Beverly Prosser became the first African-American woman to earn a PhD in psychology, which she earned from the University of Cincinnati.

1934:

• United States: Ruth Winifred Howard became the second African-American woman in the United States to receive a Ph.D. in psychology, which she earned from the University of Minnesota.

1935:

• Iran: Women were admitted to Tehran University. The access of university education to females is, in fact, also a reform regarding women's access to professions, as it open numerous professions to women.
• United States: Jesse Jarue Mark became the first African American woman to earn a Ph.D. in botany, which she earned at Iowa State University.

1936:

• United States: Flemmie Kittrell became the first African American woman to earn a Ph.D. in nutrition, which she earned at Cornell University.

1937:

• Kuwait: The first public schools open to females.
• United States: Anna Johnson Julian became the first black woman to receive a Ph.D. in sociology from the University of Pennsylvania.

1938:

• Nigeria: Elizabeth Abimbola Awoliyi became the first woman to be licensed to practise medicine in Nigeria after graduating from the University of Dublin and the first West African female medical officer with a license of the Royal Surgeon (Dublin).

1939:

• United Kingdom: Dorothy Garrod becomes the Disney Professor of Archaeology at the University of Cambridge, making her the first female professor at either Oxford or Cambridge.
1940–1969

1940:

- United States: Roger Arliner Young became the first black woman to earn a Ph.D. in zoology, which she earned from the University of Pennsylvania.

1941:

- United States: Ruth Lloyd became the first African-American woman to earn a Ph.D. in anatomy, which she earned from Western Reserve University.
- United States: Merze Tate became the first African American woman to earn a Ph.D. in government and international relations from Harvard University.

1942:

- United States: Margurite Thomas became the first African American woman to earn a Ph.D. in geology, which she earned from Catholic University.

1943:

- Iran: Compulsory primary education for both males and females.
- United States: Euphemia Haynes became the first African-American woman to earn a Ph.D. in Mathematics, which she earned from Catholic University.

1945:

- United States: Zora Neale Hurston became the first African-American woman to be admitted to Barnard college.
- United States: Harvard Medical School admitted women for the first time.

1946:

- Ghana: Jane E. Clerk was among a batch of pioneer women educators in West Africa to selected study education at the Institute of Education of the University of London.
- Ghana: Susan Ofori-Atta became the first Ghanaian woman to earn a medical degree when she graduated from the University of Edinburgh.

- United States: Marie Maynard Daly became the first African-American woman to earn a Ph.D. in chemistry, which she earned from Columbia University.

- United Kingdom: Cambridge University becomes the last university in the UK to allow women to take full degrees.

1948:

- United Kingdom: Elizabeth Hill became the first Professor of Slavonic studies at the University of Cambridge.

1949:

- United States: Joanne Simpson (formerly Joanne Malkus, born Joanne Gerould) was the first woman in the United States to receive a Ph.D. in meteorology, which she received in 1949 from the University of Chicago.

1950:

- Ghana: Matilda J. Clerk became the first woman in Ghana and West Africa to attend graduate school, earning a postgraduate diploma at the London School of Hygiene & Tropical Medicine.

- Ghana: Annie Jiagge became the first woman in Ghana to professionally qualify as a lawyer when she was called to the Bar at Lincoln's Inn.

1951:

- Bahrain: First secondary education school open to females.

- Ghana: Esther Afua Ocloo became the first person of African ancestry to obtain a cooking diploma from the Good Housekeeping Institute in London and to take the post-graduate Food Preservation Course at Long Ashton Research Station, Department of Horticulture, Bristol University.

- United States: Maryly Van Leer Peck, became first female chemical engineer graduate. Peck also became the first woman to receive an M.S. and a Ph.D. in chemical engineering from the University of Florida.

1952:
- United States: Georgia Tech's president Blake R Van Leer admitted the first women to the school and his wife Ella Wall Van Leer setup support groups for future female engineers.

1955:

- Qatar: First public school for girls.

1957:

- Southern Rhodesia (today Zimbabwe): Sarah Chavunduka became the first black woman to attend the University College of Rhodesia and Nyasaland (today the University of Zimbabwe)

1959:

- United States: Lois Graham becomes the first US woman to earn a PhD in mechanical engineering.

1962:

- United States: Martha E. Bernal, who was born in Texas, became the first Latina to earn a PhD in psychology, which she earned in clinical psychology from Indiana University Bloomington.
- Kuwait: The right to education is secured to all citizens regardless of gender.

1963:

- Nigeria: Grace Lele Williams became the first Nigerian woman to earn any doctorate when she earned her Ph.D. in Mathematics Education from the University of Chicago.
- The Gambia: Florence Mahoney became the first Gambian woman to obtain a PhD, graduating from the School of Oriental and African Studies with a doctorate in History.

1964:

- Afghanistan: The 1964 constitution stated the equal right of women to education.

1965:

- United States: Sister Mary Kenneth Keller became the first American woman to earn a PhD in Computer Science, which she earned at the University of Wisconsin–Madison. Her thesis was titled "Inductive Inference on Computer Generated Patterns."
- Kuwait: Compulsory education for both boys and girls.
1966:

- Kuwait: University education open to women.

1969:

- United States: In 1969, Lillian Lincoln Lambert became the first African-American woman to graduate from Harvard Business School with an MBA.
- United States: Princeton, Yale, Colgate, Johns Hopkins, and Georgetown opened applications to women.

1970–1999

1970:

- United States: Bowdoin, Williams and the University of Virginia allowed women to apply for admittance.

1971:

- United States: Bradford Junior College in Bradford, Massachusetts changed to Bradford College and offered four year degrees for women.
- Egypt: The new constitution confirms women's right to education.
- United States: Brown and Lehigh allowed women to apply for admittance.

1972:

- United States: Title IX was passed, making discrimination against any person based on their sex in any federally funded educational program(s) in America illegal.
- United States: Willie Hobbs Moore became the first African-American woman to receive a Ph.D. in Physics, which was conferred by the University of Michigan.
- United States: Bradford College in Bradford, Massachusetts became a co-educational institution (again) after being founded in 1803 as co-educational and then serving exclusively as a female institution of higher learning from 1837 to 1972. Bradford College closed permanently in May, 2000. The Bradford Alumni Association continues today and is the third oldest continuing alumni association in the United States.
- United States: Dartmouth, Davidson, Duke and Wesleyan allowed women to apply for admittance.

1975:
United States: Lorene L. Rogers became the first woman named president of a major research university in the United States, the University of Texas.

United States: On July 1, 1975, Jeanne Sinkford became the first female dean of a dental school when she was appointed the dean of Howard University, School of Dentistry.

United Kingdom: The Sex Discrimination Act 1975 (c. 65) is an Act of the Parliament of the United Kingdom which protected women from discrimination on the grounds of sex or marital status. The Act concerned education among other things.

United States: Amherst, Claremont, US Naval Academy, West Point, US Airforce Academy and US Coast Guard Academy allowed women to apply for admittance.

1976:


1977:

United States: Harvard’s ratio of four men to one woman ended with “sex-blind admissions.”

United States: The American Association of Dental Schools (founded in 1923 and renamed the American Dental Education Association in 2000) had Nancy Goorey as its first female president in 1977.

1978:

Afghanistan: Mandatory literacy and education of all females.

1979:

United States: Christine Economides became the first American woman to receive a PhD in petroleum engineering, which was conferred by Stanford University.

United States: Jenny Patrick became the first black woman in the United States to receive a Ph.D. in chemical engineering, which was conferred by Massachusetts Institute of Technology.

1980:

United States: Women and men were enrolled in American colleges in equal numbers for the first time.

1982:
• United States: The number of bachelor's degrees conferred on women first surpassed those conferred on men.

• United States: *Mississippi University for Women v. Hogan*, 458 U.S. 718 (1982) was a case decided 5–4 by the Supreme Court of the United States. The court held that the single-sex admissions policy of the Mississippi University for Women violated the Equal Protection Clause of the Fourteenth Amendment to the United States Constitution.

• United States: Judith Hauptman became the first woman to earn a PhD in Talmud, which she earned from the Jewish Theological Seminary in New York.

1983:

• United States: Christine Darden became the first black woman in the U.S. to receive a Ph.D. degree in mechanical engineering, which was conferred by George Washington University.

• United States: Columbia College of Columbia University allowed women to apply for admittance.

1984:

• United States: The U.S. Supreme Court's 1984 ruling *Grove City College v. Bell* held that Title IX applied only to those programs receiving direct federal aid. The case reached the Supreme Court when Grove City College disagreed with the Department of Education's assertion that it was required to comply with Title IX. Grove City College was not a federally funded institution; however, they did accept students who were receiving Basic Educational Opportunity Grants through a Department of Education program. The Department of Education's stance was that, because some of its students were receiving federal grants, the school was receiving federal assistance and Title IX applied to it. The Court decided that since Grove City College was only receiving federal funding through the grant program, only that program had to be in compliance. The ruling was a major victory for those opposed to Title IX, as it made many institutions' sports programs outside of the rule of Title IX and, thus, reduced the scope of Title IX.

1987:

• United States: Johnnetta Cole became the first black president of Spelman College.

1988:

• United States: The Civil Rights Restoration Act was passed in 1988 which extended Title IX coverage to all programs of any educational institution that receives any federal assistance, both direct and indirect.
• United States: In 1994, the Equity in Athletics Disclosure Act, sponsored by congresswoman Cardiss Collins, required federally assisted higher education institutions to disclose information on roster sizes for men's and women's teams, as well as budgets for recruiting, scholarships, coaches' salaries, and other expenses, annually.

1996:

• United States: United States v. Virginia, 518 U.S. 515 (1996), was a landmark case in which the Supreme Court of the United States struck down the Virginia Military Institute (VMI)'s long-standing male-only admission policy in a 7–1 decision. (Justice Clarence Thomas, whose son was enrolled at VMI at the time, recused himself.)

21st century

2001:

• United States: Ruth Simmons became the eighteenth president of Brown University, which made her the first black woman to lead an Ivy League institution.

2005–2006:

• United States: For the first time, more doctoral degrees are conferred on women than men in the United States. This educational gap has continued to increase in the U.S., especially for master's degrees where over 50% more degrees are conferred on women than men.

2006:

• United States: On November 24, 2006, the Title IX regulations were amended to provide greater flexibility in the operation of single-sex classes or extracurricular activities at the primary or secondary school level.

2011:

• India: In April 2011, the Institute for Buddhist Dialectical Studies (IBD) in Dharamsala, India, conferred the degree of geshe (a Tibetan Buddhist academic degree for monks and nuns) to Venerable Kelsang Wangmo, a German nun, thus making her the world's first female geshe.

2013:

• Saudi Arabia: The Saudi government sanctioned sports for girls in private schools for the first time.
• Saudi Arabia: Mai Majed Al-Qurashi became the first woman to receive a PhD in Saudi Arabia, which was conferred by the King Abdullah University of Science and Technology.

• United Kingdom: It was announced that Ephraim Mirvis created the job of ma’ayan by which women would be advisers on Jewish law in the area of family purity and as adult educators in Orthodox synagogues. This requires a part-time training course for 18 months, which is the first such course in the United Kingdom.

• Tibet: Tibetan women were able to take the geshe exams for the first time.

2016:

• Tibet: Twenty Tibetan Buddhist nuns became the first Tibetan women to receive geshema degrees.

Timeline of luminiferous aether

Early experiments

4th-century BC – Aristotle publishes Physics, in which the aether is briefly described as being an element lighter than air that surrounds celestial bodies. He describes the aether in relation to other elements - aether is lighter than air and is located above it, whereas air is lighter than water, and water is lighter than earth. In Aristotle's view, each element returns to its proper place when displaced, which explains why air rises, why earth and water fall, and why the heavens remain in place.

1704 – Isaac Newton publishes Opticks, in which he proposes a particle theory of light. This had trouble explaining diffraction, so he adds a "fudge factor," claiming that an "Aethereal Medium" is responsible for this effect, and going further to suggest it might be responsible for other physical effects such as heat.

1727 – James Bradley measures stellar aberration for the first time, proving (again) that light has a finite speed as well as that the Earth is moving.

1818 – Augustin Fresnel introduces the wave theory of light, which proposes light is a transverse wave travelling in an aether, thereby explaining how polarization can exist. It is important to note that both Newton's particle theory and Fresnel's wave theory both assume an aether exists, albeit for different reasons. From this point on, no one even seems to question its existence.

1820 – Discovery of Siméon Poisson's "Bright Spot", supporting the Wave Theory.

1830 – Fresnel develops a formula for predicting and measuring aether dragging by massive objects, based on a coupling constant. Such dragging seems to be at odds with aberration however, which would require the Earth not to drag the aether in order to be visible.

George Gabriel Stokes becomes a champion of the dragging theory.

1851 – Armand Fizeau carries out his famous experiment with light travelling through moving water. He measures fringing due to motion of the water, perfectly in line with Fresnel's formula. However he sees no
effect due to the motion of the Earth, although he does not comment on this. Nevertheless this is seen as very strong evidence for aether dragging.

1868 – Martinus Hoek carries out an improved version of Fizeau's using an interferometer experiment with one arm in water. He sees no effect at all, and cannot offer an explanation as to why his experiment is so at odds with Fizeau’s.

1871 – George Biddell Airy re-runs Bradley's experiment with a telescope filled with water. He too sees no effect. It appears that aether is not dragged by mass.

1873 – James Clerk Maxwell publishes his *Treatise on Electricity and Magnetism*.

1879 – Maxwell suggests absolute velocity of Earth in aether may be optically detectable.

1881 – Albert Abraham Michelson publishes his first interferometer experiments, using the device for the measurement of extremely small distances. To Michelson's dismay, his experiment finds no "ether drag" slowing light, as had been suggested by Fresnel.

Hendrik Antoon Lorentz finds Michelson's calculation have errors (i.e., doubling of the expected fringe shift error).

1882 – Michelson acknowledges his interpretation errors.

**Crisis**

1887 – the Michelson–Morley experiment (MMX) produces the famous null result. A small drift is seen, but it is too small to support any "fixed" aether theory, and is so small that it might be due to experimental error.

Many physicists dust off Stokes' work, and dragging becomes the "standard solution"

1887 to 1888 – Heinrich Hertz verifies the existence of electromagnetic waves.

1889 – George FitzGerald proposes the Contraction Hypothesis, which suggests that the measurements are null due to changes in the length in the direction of travel through the aether.

1892 – Oliver Lodge demonstrates that aether drag is invisible around rapidly moving celestial bodies.

1895 – Lorentz proposes independently the Contraction Hypothesis.

1902 to 1904 – Morley and Morley conduct a number of MM experiments with a 100 ft interferometer, producing the null result.

1902 to 1904 – Lord Rayleigh and DeWitt Bristol Brace found no signs of double refraction (due to FitzGerald–Lorentz Contraction) of moving bodies in the aether.

1903 – the Trouton–Noble experiment, based on an entirely different concept using electrical forces, also produces the null result.

1905 – Miller and Morley's experiment data is published. Test of the Contraction Hypothesis has negative results. Test for aether dragging effects produces null result.
1908 – the Trouton–Rankine experiment, another experiment based on electrical effects, does not detect the FitzGerald–Lorentz Contraction.

Change

1904 – Hendrik Lorentz publishes a new theory of moving bodies, without discarding the stationary (electromagnetic) ether concept.

1905 – Henri Poincaré shows that Lorentz's theory fulfills the principle of relativity, and publishes the Lorentz transformations. His model was still based on Lorentz's ether, but he argues that this aether is perfectly undetectable.

1905 – Albert Einstein publishes an observationally equivalent theory, but complete with a derivation from principles alone (leaving the ether aside). Einstein also emphasized that this concept implies the relativity of space and time. He later labelled it special relativity.

1908 – Trouton–Rankine experiment shows that length contraction of an object according to one frame does not produce a measurable change of resistance in the object's rest frame.

1913 – Georges Sagnac uses a rotating MMX device and receives a clearly positive result. The so-called Sagnac effect was considered excellent evidence for aether at the time, but was later explained via general relativity. Good explanations based on SR also exist.

1914 – Walther Zurhellen uses observations of binary stars to determine if the speed of light is dependent on movement of the source. His measurements show that it is not to $10^{-6}$. This is claimed to be additional evidence against aether dragging.

1915 – Einstein publishes on the general theory of relativity.

1919 – Arthur Eddington's Africa eclipse expedition is conducted and appears to confirm the general theory of relativity.

1920 – Einstein says that special relativity does not require rejecting the aether, and that the gravitational field of general relativity may be called aether, to which no state of motion can be attributed.

1921 – Dayton Miller conducts aether drift experiments at Mount Wilson. Miller performs tests with insulated and non-magnetic interferometers and obtains positive results.

1921 to 1924 – Miller conducts extensive tests under controlled conditions at Case University.

1924 – Miller repeats his experiments at Mount Wilson and yields a positive result.

Rudolf Tomaschek uses stars for his interferometer light source, getting the null result.

1925 – the Michelson–Gale–Pearson experiment produces a positive result while attempting to detect the effect of Earth's rotation on the velocity of light. The significance of the experiment remains debated to this day, but this planetary Sagnac effect is measured by ring laser gyros and taken into account by the GPS system.

1925 April – Meeting of the National Academy of Sciences.

Arthur Compton explains the problems with the Stokes aether drag solution.
Miller presents his positive results of the aether drag.

1925 December – American Association for the Advancement of Science meeting.

Miller proposes two theories to account for the positive result. One consists of a modified aether theory, the other a slight departure from the Contraction Hypothesis.

1926 – Roy J. Kennedy produces a null result on Mount Wilson

Auguste Piccard and Ernest Stahel produce a null result on Mont Rigi.

1927 – Mount Wilson conference.

Miller talks of partial entrainment

Michelson talks about aether drag and altitude differential effects

K. K. Illingworth produces a null result using a clever version of the MMX with a step in one mirror that dramatically improves resolution. The resolution is so good that most partial entrainment systems can be eliminated.

1929 – Michelson and F. G. Pease perform the Pearson experiment and produce a null result.

1930 – Georg Joos produces a null result using an extremely accurate interferometer placed entirely in vacuum.

1932 – the Kennedy–Thorndike experiment uses an interferometer with arms of different lengths and not at right angles. They measure over several seasons and record on photographs to allow better post-measurement study. The Kennedy Thorndike experiment becomes one of the fundamental tests for SR, proving the independence of light speed wrt to the speed of the emitting source. The other two fundamental tests are Michelson–Morley experiment (proves light speed isotropy) and Ives–Stilwell experiment (proves time dilation)

1934 – Georg Joos publishes on the Michelson–Gale–Pearson experiment, stating that it is improbable that aether would be entrained by translational motion and not by rotational motion.

1935 – Hammar experiment disproves aether entrainment

1951 – Paul Dirac writes that currently-accepted quantum field theory requires an aether, although he never formulated this theory completely.

**Debate slows**

1955 – R. S. Shankland, S. W. McCuskey, F. C. Leone, and G. Kuerti performed an analysis of Miller's results and explained them as stemming from systematic errors (Shankland's explanation is now widely accepted).

1958 – Cedarholm, Havens, and Townes use two masers frequency locked to each other and send the light in two directions. They receive the null result. The experiment is not as precise as earlier light-based MMX experiments, but demonstrates a novel setup that would become much more accurate in the future.
1964 – Jaseja, Javan, Murray and Townes repeat the earlier experiment with newer and much more precise masers.

1969 – Shamir and Fox repeat the MMX experiment with the "arms" in acrylic glass waveguides and a highly stable laser as the source. The experiment should detect a shift as small as ~0.00003 of a fringe, and none is measured.

1972 – R. S. Shankland admits he would not likely have given the effort to question Dayton Miller's work had it not been for Albert Einstein's "interest and encouragement."

1973 – Trimmer finds a null result in a triangular interferometer with one leg in glass.

1977 – Brecher repeats Zurhellen's experiment with binary pulsars, showing no difference in light speed to $2 \times 10^{-9}$

1979 Brillet and Hall use the Townes setup with highly accurate lasers, demonstrating no drift to 3 parts in $10^{15}$. The experiment also demonstrates a leftover 17 Hz signal, but the authors assume it is linked to the laboratory.

1984 – Torr and Kolen find a cyclic phase shift between two atomic clocks, but the distance between is relatively short (0.5 km) and they are clocks of the less-precise rubidium type.

1988 – Gagnon et al. measure one way light speed and detect no anisotropy

1990 – Hils and Hall repeat the Kennedy–Thorndike experiment with lasers, taking measurements over the period of a year. They find no shifting in $2 \times 10^{-13}$

Krisher et al., Phys. Rev. D, 42, No. 2, pp. 731–734, (1990) use two hydrogen masers fixed to the earth and separated by a 21 km fiber-optic link to look for variations in the phase between them. They put an upper limit on the one-way linear anisotropy of 100 m/s.

1991 – Over a six-month period, Roland DeWitte finds, over a 1.5 km underground coaxial cable, a cyclic component in the phase drift between higher-precision caesium-beam clocks on more-or-less the same meridian; the period equals the sidereal day.

2003 – Holger Mueller and Achim Peters carry out a Modern Michelson–Morley Experiment using Cryogenic Optical Resonators at Humboldt University, Berlin. They find no shifting in $10^{-15}$.

**Timeline of Jodrell Bank Observatory**

**1930s**

- 1939 — Jodrell Bank site purchased by the University of Manchester as a botany field station.
1940s

- 1945, December — Bernard Lovell arrives at Jodrell Bank with several trailers of radar equipment from World War II.
- 1947 — The 66 meter Transit Telescope is constructed.

1950s

- 1950, August — The transit telescope is used to make the first detection of radio waves from the nearby Andromeda Galaxy.
- 1950 — Charles Husband presents first drawings of the proposed giant, fully steerable radio telescope.
- 1952, September — Construction of the Mark I telescope begins.
- 1957, October — The Mark I telescope becomes operational. It tracks the carrier rocket of Sputnik 1; the only telescope in the West able to do so.

1960s

- 1960, May — Lord Nuffield pays the remaining debt on the Mark I and the observatory is renamed the Nuffield Radio Astronomy Laboratories.
- 1962 — As part of a radio-linked interferometer, the Mark I identifies a new class of compact radio sources, later recognised as quasars.
- 1962 — Jodrell Bank radio telescope is mentioned in the Science Fiction novel A for Andromeda by Fred Hoyle and John Elliot.
- 1964 — The Mark II telescope is completed.
- 1966 — The Mark I receives pictures from Luna 9, the first spacecraft to make a soft landing on the Moon.
- 1966 — The Mark III telescope is completed.
- 1968 — The Mark I confirms the existence of pulsars.
- 1968 — The Mark I took part in the first transatlantic VLBI experiment in 1968, with other telescopes being those at Algonquin and Penticton in Canada.
- 1969 — The Mark I is used for the first time in a VLBI observation, with the Arecibo radio telescope in 1969.
1970s

- 1970–1971 — The Mark I is repaired and upgraded; it is renamed to the Mark IA.
- 1972–1973 — The Mark I carries out a survey of radio sources; amongst these sources was the first gravitational lens, which was confirmed optically in 1979.
- 1976, January — storms bring winds of around 90 mph which almost destroy the telescope. Bracing girders are added.

1980s

- 1980 — The Mark IA is used as part of the new MERLIN array.
- 1982 — The 42 ft telescope is built, to replace the 50 ft.
- 1986 — The first pulsar in a globular cluster is discovered.
- 1986 — The Mark II telescope is given a new surface that is accurate to 1/3 mm.
- 1987 — The Mark IA is renamed the Lovell Telescope after Bernard Lovell.

1990s

- 1990 — The new 32 m Cambridge telescope at Mullard Radio Astronomy Observatory is added to the MERLIN array.
- 1992 — The MERLIN array becomes a national facility.
- 1993 — At the request of NASA, the Lovell Telescope searches for the Mars Observer spacecraft.
- 1998 — The Lovell Telescope begins participation with the SETI Project Phoenix

2000s

- 2000 — Placebo recorded the video for *The Bitter End* at Jodrell Bank.
- 2000–2002 — The Lovell Telescope is resurfaced, increasing its sensitivity at 5 GHz by a factor of five.
- 2004, January — Astronomers from Jodrell Bank, Australia, Italy and the U.S. discover the first known double pulsar.

2005, February — Astronomers using the Lovell Telescope discovered a galaxy that appears to be made almost entirely of dark matter.

2005, March — Jodrell Bank becomes the centre of the World's largest scale model of the Solar System as part of the Spaced Out project.

2006, September — Jodrell Bank wins the BBC's online competition to find the UK's greatest "Unsung Landmark".

**2010s**

2011, March — Jodrell Bank is included on the UK Tentative List for nomination as a UNESCO World Heritage Site

2019, July — The observatory becomes a UNESCO World Heritage Site.

**Timeline of the telephone**

**Up to 1875**

- 1667: Robert Hooke creates an acoustic string telephone that conveys sounds over a taut extended wire by mechanical vibrations.
- 1844: Innocenzo Manzetti first suggests the idea of an electric "speaking telegraph", or telephone.
- 1849: Antonio Meucci demonstrates a communicating device to individuals in Havana. It is disputed that this is an electromagnetic telephone, but it is said to involve direct transmission of electricity into the user's body.
- 1854: Charles Bourseul publishes a description of a make-and-break telephone transmitter and receiver in *L'Illustration*, (Paris) but does not construct a working instrument.
- 1854: Meucci demonstrates an electric voice-operated device in New York, but it is not clear what kind of device he demonstrated.
- 1860: Johann Philipp Reis of Germany demonstrates a make-and-break transmitter after the design of Bourseul and a knitting-needle receiver. Witnesses said they heard human voices being transmitted.
- 1861: Johann Philipp Reis transfers voice electrically over a distance of 340 feet with his Reis telephone. To prove that speech can be recognized successfully at the receiving end, he uses the phrase "The horse
does not eat cucumber salad" as an example because this phrase is hard to understand acoustically in German.

- 1864: In an attempt to give his musical automaton a voice, Innocenzo Manzetti invents the 'speaking telegraph'. He shows no interest in patenting his device, but it is reported in newspapers.

- 1865: Meucci reads of Manzetti's invention and writes to the editors of two newspapers claiming priority and quoting his first experiment in 1849. He writes "I do not wish to deny Mr. Manzetti his invention, I only wish to observe that two thoughts could be found to contain the same discovery, and that by uniting the two ideas one can more easily reach the certainty about a thing this important."

- 1871: Meucci files a patent caveat (a statement of intention to file a patent application) for a Sound Telegraph, but it does not describe an electromagnetic telephone.

- 1872: Elisha Gray founds the Western Electric Manufacturing Company.

- 1872: Professor Vanderwyde demonstrates Reis's telephone in New York.

- July 1873: Thomas Edison notes varying resistance in carbon grains due to pressure, and builds a rheostat based on the principle but abandons it because of its sensitivity to vibration.

- May 1874: Gray invents an electromagnet device for transmitting musical tones. Some of his receivers use a metallic diaphragm.

- July 1874: Alexander Graham Bell conceives the theoretical concept for the telephone while vacationing at his parents' farm near Brantford, Canada. Alexander Melville Bell records notes of his son's conversation in his personal journal.

- 29 December 1874: Gray demonstrates his musical tones device and transmits "familiar melodies through telegraph wire" at the Presbyterian Church in Highland Park, Illinois.

- 4 May 1875: Bell conceives of using varying resistance in a wire conducting electric current to create a varying current amplitude.

- 2 June 1875: Bell transmits the sound of a plucked steel reed using electromagnet instruments.

- 1 July 1875: Bell uses a bi-directional "gallows" telephone that was able to transmit "indistinct but voice-like sounds" but not clear speech. Both the transmitter and the receiver were identical membrane electromagnet instruments.

- 1875: Thomas Edison experiments with acoustic telegraphy and, in November, builds an electro-dynamic receiver but does not exploit it.

**1876 to 1878**

- 11 February 1876: Elisha Gray invents a liquid transmitter for use with a telephone, but he did not make one.
14 February 1876, about 9:30 am: Gray or his lawyer brings Gray's patent caveat for the telephone to the Washington, D.C. Patent Office (a caveat was a notice of intention to file a patent application. It was like a patent application, but without a request for examination, for the purpose of notifying the patent office of a possible invention in process).

14 February 1876, about 11:30 am: Bell's lawyer brings to the same patent office Bell's patent application for the telephone. Bell's lawyer requests that it be registered immediately in the cash receipts blotter.

14 February 1876, about 1:30 pm: Approximately two hours later Elisha Gray's patent caveat is registered in the cash blotter. Although his caveat was not a full application, Gray could have converted it into a patent application and contested Bell's priority, but did not do so because of advice from his lawyer and his involvement with acoustic telegraphy. The result was that the patent was awarded to Bell.

7 March 1876: Bell's U.S. Patent, No. 174,465 for the telephone is granted.

10 March 1876: Bell first successfully transmits speech, saying "Mr. Watson, come here! I want to see you!" using a liquid transmitter as described in Gray's caveat, and Bell's own electromagnetic receiver.

16 May 1876: Thomas Edison files first patent application for acoustic telegraphy for which U.S. patent 182,996 was granted October 10, 1876.

25 June 1876: Bell exhibits his telephone at the Centennial Exposition in Philadelphia, where it draws enthusiastic reactions from Emperor Dom Pedro II of Brazil and Lord Kelvin, attracting the attention of the press and resulting in the first announcements of the invention to the general public. Lord Kelvin describes the telephone as "the greatest by far of all the marvels of the electric telegraph".

10 August 1876: Alexander Graham Bell makes the world's first long-distance telephone call, one-way, not reciprocal, over a distance of about 6 miles, between Brantford and Paris, Ontario, Canada.

1876: Hungarian Tivadar Puskás invents the telephone switchboard exchange (later working with Edison).

9 October 1876: Bell makes the first two-way long-distance telephone call between Cambridge and Boston, Massachusetts.

October 1876: Edison tests his first carbon microphone.

1877: The first experimental Telephone Exchange in Boston.

20 January 1877: Edison "first [succeeds] in transmitting over wires many articulated sentences" using carbon granules as a pressure-sensitive varying resistance under the pressure of a diaphragm.

30 January 1877: Bell's U.S. Patent No. 186,787 is granted for an electromagnetic telephone using permanent magnets, iron diaphragms, and a call bell.

4 March 1877: Emile Berliner invents a microphone based on "loose contact" between two metal electrodes, an improvement on Reis' Telephone, and in April 1877 files a caveat of an invention in process.

April 1877: A telephone line connects the workshop of Charles Williams, Jr., located in Boston, to his house in Somerville, Massachusetts at 109 Court Street in Boston, where Alexander Graham
Bell and Thomas Watson had previously experimented with their telephone. The telephones became No. 1 and 2 in the Bell Telephone Company.

- 27 April 1877: Edison files telephone patent applications. U.S. patents (Nos. 474,230, 474,231 and 474,232) were awarded to Edison in 1892 over the competing claims of Alexander Graham Bell, Emile Berliner, Elisha Gray, Amos Dolbear, J.W. McDonagh, G.B. Richmond, W.L.W. Voeker, J.H. Irwin and Francis Blake Jr. Edison's carbon granules transmitter and Bell's electromagnetic receiver are used, with improvements, by the Bell system for many decades thereafter.
- 4 June 1877: Emile Berliner files telephone patent application that includes a carbon microphone transmitter.
- 9 July 1877: The Bell Telephone Company, a common law joint-stock company, is organized by Alexander Graham Bell's future father-in-law Gardiner Greene Hubbard, a lawyer who becomes its first president.
- 6 October 1877: the Scientific American publishes the invention from Bell – at that time still without a ringer.
- 25 October 1877: the article in the Scientific American is discussed at the Telegraphenamt in Berlin
- November 1877: First permanent telephone connection in UK between two businesses in Manchester using imported Bell instruments.
- 12 November 1877: The first commercial telephone company enters telephone business in Friedrichsberg close to Berlin using the Siemens pipe as ringer and telephone devices built by Siemens.
- 1 December 1877: Western Union enters the telephone business using Edison's superior carbon microphone transmitter.
- 14 January 1878: Bell demonstrates the device to Queen Victoria and gives her an opportunity to try it. Calls are made to Cowes, Southampton and London, the first long-distance calls in the UK. The queen asks to buy the equipment that was used, but Bell offers to make a model specifically for her.
- 4 February 1878: Edison demonstrates the telephone between Menlo Park, New Jersey and Philadelphia, a distance of 210 kilometres (130 mi).
- 14 June 1878: The Telephone Company (Bell's Patents) Ltd. is registered in London. Opened in London on 21 August 1879, it is Europe's first telephone exchange, followed a couple of weeks later by one in Manchester.
- 12 September 1878: the Bell Telephone Company sues Western Union for infringing Bell's patents.
- 1878: The first Australian telephone trials were made between Semaphore and Kapunda (and later Adelaide and Port Adelaide) in South Australia.
1879 to 1919

- Early months of 1879: The Bell Telephone Company is near bankruptcy and desperate to get a transmitter to equal Edison's carbon transmitter.
- 17 February 1879: Bell Telephone merges with the New England Telephone Company to form the National Bell Telephone Company. Theodore Vail takes over operations.
- 1879: Francis Blake invents a carbon transmitter similar to Edison's that saves the Bell company from extinction.
- 10 September 1879: Connolly and McTighe patent a "dial" telephone exchange (limited in the number of lines to the number of positions on the dial.).
- 1879: The International Bell Telephone Company (IBTC) of Brussels, Belgium was founded by Bell Telephone Company president Gardiner Greene Hubbard, initially to sell imported telephones and switchboards in Continental Europe. International Bell rapidly evolved into an important European telephone service provider and manufacturer, with major operations in several countries.
- 19 February 1880: The photophone, also called a radiophone, is invented jointly by Alexander Graham Bell and Charles Sumner Tainter at Bell's Volta Laboratory. The device allowed for the transmission of sound on a beam of light.
- 20 March 1880: National Bell Telephone merges with others to form the American Bell Telephone Company.
- 1 April 1880: world's first wireless telephone call on Bell and Tainter's photophone (distant precursor to fiber-optic communications) from the Franklin School in Washington, D.C. to the window of Bell's laboratory, 213 meters away.
- 1 July 1881: The world's first international telephone call is made between St. Stephen, New Brunswick, Canada, and Calais, Maine, United States.
- 11 October 1881: The Sydney telephone exchange opened with 12 subscribers.
- 1882: A telephone company—an American Bell Telephone Company affiliate—is set up in Mexico City.
- 14 May 1883: The Adelaide exchange was opened, with 48 subscribers.
- 7 September 1883: The Port Adelaide exchange was opened, with 21 subscribers.
- 4 September 1884: Opening of telephone service between New York and Boston (235 miles).
- 3 March 1885: The American Telephone & Telegraph Company (AT&T) is incorporated as the long-distance division of American Bell Telephone Company. It will become the head of the Bell System on the last day of 1899.
• 1886: Gilliland's *Automatic circuit changer* is put into service between Worcester and Leicester featuring the first operator dialing allowing one operator to run two exchanges.

• 1887: Tivadar Puskás introduced the multiplex switchboard, that had an epochal significance in the further development of telephone exchange.

• 13 January 1887: the Government of the United States moves to annul the master patent issued to Alexander Graham Bell on the grounds of fraud and misrepresentation. The case, known as the 'Government Case', is later dropped after it was revealed that the U.S. Attorney General, Augustus Hill Garland had been given millions of dollars of stock in the company trying to unseat Bell's telephone patent.

• 1888: Telephone patent court cases are confirmed by the Supreme Court, see The Telephone Cases

• 1889: AT&T becomes the overall holding company for all the Bell companies.

• 2 November 1889: A.G. Smith patents a telegraph switch which provides for trunks between groups of selectors allowing for the first time, fewer trunks than there are lines, and automatic selection of an idle trunk.

• 10 March 1891: Almon Strowger patents the Strowger switch the first Automatic telephone exchange.

• 30 October 1891: The independent Strowger Automatic Telephone Exchange Company is formed.

• 3 May 1892: Thomas Edison awarded patents for the carbon microphone based on applications lodged in 1877.

• 18 October 1892: Opening of telephone service between New York and Chicago (950 miles).

• 3 November 1892: The first Strowger switch goes into operation in LaPorte, Indiana with 75 subscribers and capacity for 99.

• 30 January 1894: The second fundamental Bell patent for the telephone expires; Independent telephone companies established, and independent manufacturing companies (Stromberg-Carlson in 1894 and Kellogg Switchboard & Supply Company in 1897).

• 30 December 1899: American Bell Telephone Company is purchased by its own long-distance subsidiary, American Telephone and Telegraph (AT&T) to bypass state regulations limiting capitalization. AT&T assumes leadership role of the Bell System.

• 25 December 1900: John W. Atkins, the manager at International Ocean Telegraph Company (IOTC), a subsidiary of Western Union Telegraph Company made the first international telephone call over telegraph cable at 09:55am from his office in Key West to Havana, Cuba. Atkins was reported in the Florida Times Union and Citizen as saying, "For a long time there was no sound, except the roar heard at night sometimes, caused by electric light current." He continued calling Cuba and finally came back the words, clear and distinct: "I don't understand you."

• 27 February 1901: United States Court of Appeal declares void Emile Berliner's patent for a telephone transmitter used by the Bell telephone system
1902: The first Australian interstate calls between Mount Gambier and Nelson.

26 February 1914: Boston-Washington underground cable commenced commercial service.

16 January 1915: The first automatic Panel exchange was installed at the Mulberry Central Office in Newark, New Jersey; but was a semi-automatic system using non-dial telephones.

25 January 1915: First transcontinental telephone call (3600 miles), with Thomas Augustus Watson at 333 Grant Avenue in San Francisco receiving a call from Alexander Graham Bell at 15 Dey Street in New York City, facilitated by a newly invented vacuum tube amplifier.

21 October 1915: First transmission of speech across the Atlantic Ocean by radiotelephone from Arlington, Virginia to Paris, France.

1919: The first rotary dial telephones in the Bell System installed in Norfolk, Virginia. Telephones that lacked dials and touch-tone pads were no longer made by the Bell System after 1978.

1919: AT&T conducts more than 4,000 measurements of people's heads to gauge the best dimensions of standard headsets so that callers' lips would be near the microphone when holding handsets up to their ears.

1920 to 1969

16 July 1920: World's first radiotelephone service commences public service between Los Angeles and Santa Catalina Island.

11 April 1921: Opening of deep sea cable from Key West, Florida, to Havana, Cuba (115 miles).

22 December 1923: Opening of second transcontinental telephone line via a southern route.

7 March 1926: First transatlantic telephone call, from London to New York.

7 January 1927: Transatlantic telephone service inaugurated for commercial service (3500 miles).

17 January 1927: Opening of third transcontinental telephone line via a northern route.

7 April 1927: World's first videophone call via an electro-mechanical AT&T unit, from Washington, D.C. to New York City, by then-Commerce Secretary Herbert Hoover.

8 December 1929: Opening of commercial ship-to-shore telephone service.

3 April 1930: Opening of transoceanic telephone service to Argentina, Chile, and Uruguay and subsequently to all other South American countries.

25 April 1935: First telephone call around the world by wire and radio.

1937: The Western Electric type 302 telephone becomes available for service in the United States.

8 December 1937: Opening of fourth transcontinental telephone line.

1941: Multi-frequency dialing introduced for operators in Baltimore, Maryland.
• 1942: Telephone production is halted at Western Electric until 1945 for civilian distribution due to the retooling of factories for military equipment during World War II.

• 1946: National Numbering Plan (area codes)

• 1946: first commercial mobile phone call

• 1946: Bell Labs develops the germanium point-contact transistor

• 1947: December, W. Rae Young and Douglas H. Ring, Bell Labs engineers, proposed hexagonal cells for provisioning of mobile telephone service.

• 1948: Phil Porter, a Bell Labs engineer, proposed that cell towers be at the corners of the hexagons rather than the centers and have directional antennas pointing in 3 directions.

• 1950: The Western Electric Type 500 telephone becomes available in the United States after announcement in 1949.

• 30 June 1948: First public demonstration of the transistor by Bell Telephone Laboratories.

• 10 November 1951: Direct Distance Dialing (DDD) first offered on trial basis at Englewood, New Jersey, to 11 selected major cities across the United States; this service grew rapidly across major cities during the 1950s

• 1955: the laying of trans-Atlantic cable TAT-1 began – 36 circuits, later increased to 48 by reducing the bandwidth from 4 kHz to 3 kHz

• 1958: Modems used for direct connection via voice phone lines

• 1959: The Princess telephone is introduced in the Bell System in the United States.

• 1959: UKs first public car radio-telephone service opens in Liverpool and Manchester

• 1959: Mohamed M. Atalla and Dawon Kahng at Bell Telephone Laboratories invent the metal–oxide–semiconductor field-effect transistor (MOSFET, or MOS transistor), which later enables the rapid development and wide adoption of pulse-code modulation (PCM) digital telephony.

• 1960: Bell Labs conducts extensive field trial of an electronic central office in Morris, Illinois, known at the Morris System.

• 1960s: Bell Labs developed the electronics for cellular phones

• 1961: Initiation of Touch-Tone service trials

• 1962: T-1 service in Skokie, Illinois

• 1963, November 18: AT&T commences the first subscriber Touch-Tone service in the towns of Carnegie and Greensburg, Pennsylvania, using push-button telephones that replaced rotary dial instruments.

• 1965 (May 31): The world's first electronic switching system commences commercial service in Succasunna, New Jersey in form of the 1ESS.
• 1965: first geosynchronous communications satellite – 240 circuits or one TV signal
• 1965: The Trimline telephone is introduced by Western Electric for use in the Bell System.

1970 to 1999

• 1970: ESS-2 electronic switch.
• 1970: modular telephone cords and jacks introduced.
• 1970: Amos E. Joel, Jr. of Bell Labs invented the "call handoff" system for "cellular mobile communication system" (patent granted 1972).
• 1970: British companies Pye TMC, Marconi-Elliott and GEC develop the digital push-button telephone, based on metal-oxide-semiconductor (MOS) integrated circuit (IC) technology. It uses MOS memory chips to store phone numbers, which could then be used for speed dialing.
• 1971: AT&T submitted a proposal for cellular phone service to the U.S. Federal Communications Commission (FCC).
• 3 April 1973: Motorola employee Martin Cooper placed the first hand-held cell phone call to Joel Engel, head of research at AT&T's Bell Labs, while talking on the first Motorola DynaTAC prototype.
• 1973: Bell Labs combined MOS technology with touch-tone technology to develop a push-button MOS touch-tone phone called the "Touch-O-Matic" telephone, which uses MOS integrated circuit chips and could store up to 32 phone numbers.
• 1974: David A. Hodges, Paul R. Gray and R.E. Suarez at UC Berkeley develop MOS mixed-signal integrated circuit technology, in the form of the MOS switched capacitor (SC) circuit, which they use to develop the digital-to-analog converter (DAC) chip used in digital telephony.
• 1975: Paul R. Gray and J. McCreary develop the analog-to-digital converter (ADC) MOS chip, used in digital telephony.
• 1976: Kazuo Hashimoto invented Caller ID
• 1978: Bell Labs launched a trial of the first commercial cellular network in Chicago using Advanced Mobile Phone System (AMPS).
• 1978: World's first NMT phone call in Tampere, Finland.
• 1979: VoIP – NVP running on top of early versions of IP
• 1980: W.C. Black and David A. Hodges develop the silicon-gate CMOS (complementary MOS) pulse-code modulation (PCM) codec-filter chip, which has since been the industry standard for digital telephony, widely used in the public switched telephone network (PSTN) as well as cordless telephones and cell phones.
• 1981: The world's first fully automatic mobile phone system NMT is started in Sweden and Norway.
• 1981: BT introduces the British Telephone Sockets system.
• 1982: FCC approved AT&T proposal for AMPS and allocated frequencies in the 824-894 MHz band.
• 1982: Caller ID patented by Carolyn Doughty, Bell Labs
• 1983: last manual telephone switchboard in Maine is retired
• 1984: AT&T completes the divestiture of its local operating companies. This forms a new AT&T (long-distance service and equipment sales) and the Baby Bells.
• 1987: ADSL introduced
• 1988: First transatlantic fiber optic cable TAT-8, carrying 40,000 circuits
• 1990: analog AMPS was superseded by Digital AMPS.
• 1991: the GSM mobile phone network is started in Finland, with the first phone call in Tampere.
• 1993: Telecom Relay Service available for the disabled
• 1994: The IBM Simon becomes the first smartphone on the market.
• 1995: Caller ID implemented nationally in USA
• 1999: creation of the Asterisk Private branch exchange

2000 to present

• 11 June 2002: Antonio Meucci is recognized for "...his work in the invention of the telephone" (but not "...for inventing the telephone") by the United States House of Representatives, in United States HRes. 269.
• 21 June 2002: The Parliament of Canada responds by passing a motion unanimously 10 days later recognizing Alexander Graham Bell as the inventor of the telephone.
• 2005: Mink, Louisiana finally receives traditional landline telephone service (one of the last in the United States).

Timeline of telescope technology
BC

2560 BC to 1 BC

- c.2560 BC–c.860 BC — Egyptian artisans polish rock crystal, semi-precious stones, and latterly glass to produce facsimile eyes for statuary and mummy cases. The intent appears to be to produce an optical illusion.
- c.470 BC–c.390 BC — Chinese philosopher Mozi writes on the use of concave mirrors to focus the sun's rays.
- 424 BC Aristophanes "lens" is a glass globe filled with water. (Seneca says that it can be used to read letters no matter how small or dim)
- 3rd century BC Euclid is the first to write about reflection and refraction and notes that light travels in straight lines

AD

1 AD to 999 AD

- 2nd century AD — Ptolemy (in his work Optics) wrote about the properties of light including: reflection, refraction, and colour.
- 984 — Ibn Sahl completes a treatise On Burning Mirrors and Lenses, describing plano-convex and biconvex lenses, and parabolic and ellipsoidal mirrors.

1000 AD to 1999 AD

- 1011–1021 — Ibn al-Haytham (also known as Alhacen or Alhazen) writes the Kitab al-Manazir (Book of Optics)
- 12th century — Ibn al-Haytham's Book of Optics is introduced to Europe translated into Latin.
- 1230–1235 — Robert Grosseteste describes the use of 'optics' to "...make small things placed at a distance appear any size we want, so that it may be possible for us to read the smallest letters at incredible distances..." ("Haec namque pars Perspectivae perfecte cognita ostendit nobis modum, quo res longissime distantes faciamus apparere propinquissime positas et quo res magnas propinquas faciamus apparere brevissimas et quo res longe positas parvas faciamus apparere quantum volumus magnas, ita ut possible sit nobis ex incredibili distantia litteras minimas legere, aut arenam, aut granum, aut gramina, aut quaevis minuta numerare.") in his work De Iride.
- 1266 — Roger Bacon mentions the magnifying properties of transparent objects in his treatise Opus Majus.
Witelo writes *Perspectiva* — "Optics" incorporating much of *Kitab al-Manazir*.

1285–1300 spectacles are invented.

1570 — The writings of Thomas Digges describes how his father, English mathematician and surveyor Leonard Digges (1520–1559), made use of a "proportional Glass" to view distant objects and people. Some, such as the historian Colin Ronan, claim this describes a reflecting or refracting telescope built between 1540 and 1559 but its vague description and claimed performance makes it dubious.

1570s — Ottoman astronomer and engineer Taqi al-Din seems to describe a rudimentary telescope in his *Book of the Light of the Pupil of Vision and the Light of the Truth of the Sights*. He also states that he wrote another earlier treatise explaining the way this instrument is made and used, suggesting that he invented it some time before 1574.

1586 Giambattista della Porta writes "...to make glasses that can recognize a man several miles away" It is unclear whether he is describing a telescope or corrective glasses.

1608 — Hans Lippershey, a Dutch lensmaker, applies for a patent for a *perspective glass* "for seeing things far away as if they were nearby", the first recorded design for what will later be called a *telescope*. His patent beats fellow Dutch instrument-maker's Jacob Metius's patent by a few weeks. A claim will be made 37 years later by another Dutch spectacle-maker that his father, Zacharias Janssen, invented the telescope.

1609 — Galileo Galilei makes his own improved version of Lippershey's telescope, calling it a "perspicillum".

1611 — Greek mathematician Giovanni Demisiani coins the word "telescope" (from the Greek τῆλε, tele "far" and σκόπειν, skopein "to look or see"; τηλεσκόπος, teleskopos "far-seeing") for one of Galileo Galilei's instruments presented at a banquet at the Accademia dei Lincei.

1611 — Johannes Kepler describes the optics of lenses (see his books *Astronomiae Pars Optica* and *Dioptrice*), including a new kind of astronomical telescope with two convex lenses (the 'Keplerian' telescope).

1616 — Niccolò Zucchi claims at this time he experimented with a concave bronze mirror, attempting to make a reflecting telescope.

1630 — Christoph Scheiner constructs a telescope to Kepler's design.

1650 — Christiaan Huygens produces his design for a compound eyepiece.

1663 — Scottish mathematician James Gregory designs a reflecting telescope with paraboloid primary mirror and ellipsoid secondary mirror. Construction techniques at the time could not make it, and a workable model was not produced until 10 years later by Robert Hooke. The design is known as 'Gregorian'.

1668 — Isaac Newton produces the first functioning reflecting telescope using a spherical primary mirror and a flat diagonal secondary mirror. This design is termed the 'Newtonian'.

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• 1672 — Laurent Cassegrain, produces a design for a reflecting telescope using a paraboloid primary mirror and a hyperboloid secondary mirror. The design, named 'Cassegrain', is still used in astronomical telescopes used in observatories in 2006.

• 1674 — Robert Hooke produces a reflecting telescope based on the Gregorian design.

• 1684 — Christiaan Huygens publishes "Astroscopia Compendiaria" in which he described the design of very long aerial telescopes.

• 1720 — John Hadley develops ways of aspherizing spherical mirrors to make very accurate parabolic mirrors and produces a much improved Gregorian telescope.

• 1721 — John Hadley experiments with the neglected Newtonian telescope design and demonstrates one with a 6-inch parabolic mirror to the Royal Society.

• 1730s — James Short succeeds in producing a Gregorian telescopes to true paraboloidal primary and ellipsoidal secondary design specifications.

• 1733 — Chester Moore Hall invents the achromatic lens.

• 1758 — John Dollond re-invents and patents the achromatic lens.

• 1783 — Jesse Ramsden invents his eponymous eyepiece.

• 1803 — The "Observatorio Astronómico Nacional de Colombia (OAN)" is inaugurated as the first observatory in the Americas in Bogotá, Colombia.

• 1849 — Carl Kellner designs and manufactures the first achromatic eyepiece, announced in his paper "Das orthoskopische Ocular".

• 1857 — Léon Foucault improves reflecting telescopes when he introduced a process of depositing a layer of silver on glass telescope mirrors.

• 1860 — Georg Simon Plössl produces his eponymous eyepiece.

• 1880 — Ernst Abbe designs the first orthoscopic eyepiece (Kellner's was solely achromatic rather than orthoscopic, despite his description).

• 1897 — Largest practical refracting telescope, the Yerkes Observatory's 40 inch (101.6 cm) refractor, is built.

• 1900 — The largest refractor ever, Great Paris Exhibition Telescope of 1900 with an objective of 49.2 inch (1.25 m) diameter is temporarily exhibited at the Paris 1900 Exposition.

• 1910s — George Willis Ritchey and Henri Chrétien co-invent the Ritchey-Chrétien telescope used in many, if not most of the largest astronomical telescopes.

• 1930 — Bernhard Schmidt invents the Schmidt camera.

• 1932 — John Donovan Strong first "aluminizes" a telescope mirror a much longer lasting aluminium coating using thermal vacuum evaporation.
• 1944 — Dmitri Dmitrievich Maksutov invents the Maksutov telescope.
• 1967 — The first neutrino telescope opened in Africa.
• 1970 — The first space observatory, Uhuru, is launched, being also the first gamma-ray telescope.
• 1975 — BTA-6 is the first major telescope to use an altazimuth mount, which is mechanically simpler but requires computer control for accurate pointing.
• 1990 — Hubble Space Telescope (HST) was launched into low Earth orbit

2000 CE to 2025 CE

• 2003 — The Spitzer Space Telescope (SST), formerly the Space Infrared Telescope Facility (SIRTF), is an infrared space observatory launched in 2003. It is the fourth and final of the NASA Great Observatories program
• 2008 — Max Tegmark and Matias Zaldarriaga created the Fast Fourier Transform Telescope.
• 2021 — The James Webb telescope is to be launched by NASA.

Timeline of psychology

Ancient history – BCE

• c. 1550 BCE – The Ebers Papyrus mentioned depression and thought disorders.
• c. 600 BCE – Many cities in Greece had temples to Asklepios that provided cures for psychosomatic illnesses.
• 540–475 Heraclitus
• c. 500 Alcmaeon - suggested theory of humors as regulating human behavior (similar to Empedocles' elements)
• 500–428 Anaxagoras
• 490–430 Empedocles proposed a first natural, non-religious system of factors that create things around, including human characters. In his model he used four elements (water, fire, earth, air) and four seasons to derive diversity of natural systems.
• 490–421 Protagoras
• 470–399 Socrates – Socrates has been called the father of western philosophy, if only via his influence on Plato and Aristotle. Socrates made a major contribution to pedagogy via his dialectical method and to epistemology via his definition of true knowledge as true belief buttressed by some rational justification.
• 470–370 Democritus – Democritus distinguished between insufficient knowledge gained through the senses and legitimate knowledge gained through the intellect—an early stance on epistemology.

• 460 BC – 370 BCE – Hippocrates introduced principles of scientific medicine based upon naturalistic observation and logic, and denied the influence of spirits and demons in diseases. Introduced the concept of "temperamentum"("mixture", i.e. 4 temperament types based on a ratio between chemical bodily systems. Hippocrates was among the first physicians to argue that brain, and not the heart is the organ of psychic processes.

• 387 BCE – Plato suggested that the brain is the seat of mental processes. Plato's view of the "soul" (self) is that the body exists to serve the soul: "God created the soul before the body and gave it precedence both in time and value, and made it the dominating and controlling partner." from Timaeus

• c. 350 BCE – Aristotle wrote on the ψυχή (soul) in De Anima, first mentioning the tabula rasa concept of the mind.

• c. 340 BCE – Praxagoras

• 371–288 Theophrastus

• 341–270 Epicurus

• c. 320 Herophilus

• c. 300–30 Zeno of Citium taught the philosophy of Stoicism, involving logic and ethics. In logic, he distinguished between imperfect knowledge offered by the senses and superior knowledge offered by reason. In ethics, he taught that virtue lay in reason and vice in rejection of reason. Stoicism inspired Aaron Beck to introduce cognitive behavioral therapy in the 1970s.

• 304–250 Erasistratus

• 123–43 BCE – Themison of Laodicea was a pupil of Asclepiades of Bithynia and founded a school of medical thought known as "methodism." He was criticized by Soranus for his cruel handling of mental patients. Among his prescriptions were darkness, restraint by chains, and deprivation of food and drink. Juvenal satirized him and suggested that he killed more patients than he cured.

• c. 100 BCE – The Dead Sea Scrolls noted the division of human nature into two temperaments.

First century

• c. 50 – Aulus Cornelius Celsus died, leaving De Medicina, a medical encyclopedia; Book 3 covers mental diseases. The term insania, insanity, was first used by him. The methods of treatment included bleeding, frightening the patient, emetics, enemas, total darkness, and decoctions of poppy or henbane, and pleasant ones such as music therapy, travel, sport, reading aloud, and massage. He was aware of the importance of the doctor-patient relationship.
• c. 100 – Rufus of Ephesus believed that the nervous system was instrumental in voluntary movement and sensation. He discovered the optic chiasma by anatomical studies of the brain. He stressed taking a history of both physical and mental disorders. He gave a detailed account of melancholia, and was quoted by Galen.

• 93–138 – Soranus of Ephesus advised kind treatment in healthy and comfortable conditions, including light, warm rooms.

Second century

• c. 130–200 – Galen "was schooled in all the psychological systems of the day: Platonic, Aristotelian, Stoic, and Epicurean" He advanced medicine by offering anatomic investigations and was a skilled physician. Galen developed further the theory of temperaments suggested by Hippocrates, that people's characters were determined by the balance among four bodily substances. He also distinguished sensory from motor nerves and showed that the brain controls the muscles.

• c. 150–200 – Aretaeus of Cappadocia

Third century

• 155–220 Tertullian

• 205–270 Plotinus wrote Enneads a systematic account of Neoplatonist philosophy, also nature of visual perception and how memory might work.

Fourth century

• c. 323–403 – Oribasius compiled medical writings based on the works of Aristotle, Asclepiades, and Soranus of Ephesus, and wrote on melancholia in Galenic terms.

• 345–399 – Evagrius Ponticus described a rigorous way of introspection within the early Christian monastic tradition. Through introspection, monks could acquire self-knowledge and control their stream of thought which signified potentially demonic influences. Ponticus developed this view in Praktikos, his guide to ascetic life.

• c. 390 – Nemesius wrote De Natura Hominis (On Human Nature); large sections were incorporated in Saint John Damascene's De Fide Orthodoxia in the eighth century. Nemesius' book De Placitis Hippocratis et Platonis (On the Doctrines of Hippocrates and Plato) contains many passages concerning Galen's anatomy and physiology, believing that different cavities of the brain were responsible for different functions.
• 397–398 – St. Augustine of Hippo published *Confessions*, which anticipated Freud by near-discovery of the subconscious. Augustine's most complete account of the soul is in *De Quantitate Animae* (The Greatness of the Soul). The work assumes a Platonic model of the soul.

**Fifth century**

• 5th century – Caelius Aurelianus opposed harsh methods of handling the insane, and advocated humane treatment.

• c. 423–529 – Theodosius the Cenobiarch founded a monastery at Kathismus, near Bethlehem. Three hospitals were built by the side of the monastery: one for the sick, one for the aged, and one for the insane.

• c. 451 – Patriarch Nestorius of Constantinople: his followers dedicated themselves to the sick and became physicians of great repute. They brought the works of Hippocrates, Aristotle, and Galen, and influenced the approach to physical and mental disorders in Persia and Arabia.

**Seventh century**

• 625–690 – Paul of Aegina suggested that hysteria should be treated by ligature of the limbs, and mania by tying the patient to a mattress placed inside a wicker basket and suspended from the ceiling. He also recommended baths, wine, special diets, and sedatives for the mentally ill. He described the following mental disorders: phrenitis, delirium, lethargus, melancholia, mania, incubus, lycanthropy, and epilepsy.

**Ninth century**

• c. 800 – The first bimaristan was built in Baghdad. By the 13th century, bimaristans grew into hospitals with specialized wards, including wards for mentally ill patients.

• c. 850 – Ali ibn Sahl Rabban al-Tabari wrote a work emphasizing the need for psychotherapy.

**Tenth century**

• c. 900 – Ahmed ibn Sahl al-Balkhi urged doctors to ensure that they evaluated the state of both their patients' bodies and souls, and highlighted the link between spiritual or mental health and overall health.

• c. 900 – al-Razi (Rhazes) promoted psychotherapy and an understanding attitude towards those suffering from psychological distress.
Eleventh century

- 1025 – In *The Canon of Medicine*, Avicenna described a number of conditions, including hallucination, insomnia, mania, nightmare, melancholia, dementia, epilepsy, paralysis, stroke, vertigo and tremor.

- c. 1030 – Al-Biruni employed an experimental method in examining the concept of reaction time.

Twelfth century

- c. 1200 – Maimonides wrote about neuropsychiatric disorders, and described rabies and belladonna intoxication.

Thirteenth century

- c. 1180 – 1245 Alexander of Hales
- c. 1190 – 1249 William of Auvergne
- 1215–1277 Peter Juliani taught in the medical faculty of the University of Siena, and wrote on medical, philosophical and psychological topics. He was personal physician to Pope Gregory X and later became archbishop and cardinal. He was elected pope under the name John XXI in 1276.
- c. 1214 – 1294 Roger Bacon advocated for empirical methods and wrote on optics, visual perception, and linguistics.
- 1221–1274 Bonaventure
- 1193–1280 Albertus Magnus
- 1225 – Thomas Aquinas
- 1240 – Bartholomeus Anglicus published *De Proprietatibus Rerum*, which included a dissertation on the brain, recognizing that mental disorders can have a physical or psychological cause.
- 1247 – Bethlehem Royal Hospital in Bishopsgate outside the wall of London, one of the most famous old psychiatric hospitals was founded as a priory of the Order of St. Mary of Bethlem to collect alms for Crusaders; after the English government secularized it, it started admitting mental patients by 1377 (c. 1403), becoming known as Bedlam Hospital; in 1547 it was acquired by the City of London, operating until 1948; it is now part of the British NHS Foundation Trust.
- 1266–1308 Duns Scotus
- c. 1270 – Witelo wrote *Perspectiva*, a work on optics containing speculations on psychology, nearly discovering the subconscious.
• 1295 Lanfranc writes *Science of Cirurgie*

**Fourteenth century**

• 1317–40 – William of Ockham, an English Franciscan friar and scholastic philosopher and theologian, is commonly known for Occam's razor, the methodological principle that the simplest explanation is to be preferred. He also produced significant works on logic, physics, and theology, advancing his thoughts about intuitive and abstracted knowledge.

• 1347–50 – The Black Death devastated Europe.

• c. 1375 – English authorities regarded mental illness as demonic possession, treating it with exorcism and torture.

**Fifteenth century**

• c. 1400 – Renaissance Humanism caused a reawakening of ancient knowledge of science and medicine.

• 1433–1499 Marsilio Ficino was a renowned figure of the Italian Renaissance, a Neoplatonist humanist, a translator of Greek philosophical writing, and the most influential exponent of Platonism in Italy in the fifteenth century.

• c. 1450 – The pendulum in Europe swings, bringing witch mania, causing thousands of women to be executed for witchcraft until the late 17th century.

**Sixteenth century**

• 1590 – Scholastic philosopher Rudolph Goclenius coined the term "psychology"; though usually regarded as the origin of the term, there is evidence that it was used at least six decades earlier by Marko Marulić.

**Seventeenth century**

• c. 1600–1625 – Francis Bacon was an English philosopher, statesman, scientist, lawyer, jurist, author, and pioneer of the scientific method. His writings on psychological topics included the nature of knowledge and memory.

• 1650 – René Descartes died, leaving *Treatise of the World*, containing his dualistic theory of reality, mind vs. matter.

• 1672 – Thomas Willis published the anatomical treatise *De Anima Brutorum*, describing psychology in terms of brain function.
• 1677 – Baruch Spinoza died, leaving Ethics, Demonstrated in Geometrical Order, Pt. 2 focusing on the human mind and body, disputing Descartes and arguing that they are one, and Pt. 3 attempting to show that moral concepts such as good and evil, virtue, and perfection have a basis in human psychology.

• 1689 – John Locke published An Essay Concerning Human Understanding, which claims that the human mind is a Tabula Rasa at birth.

Eighteenth century

• 1701 – Gottfried Wilhelm Leibniz published the Law of Continuity, which he applied to psychology, becoming the first to postulate an unconscious mind; he also introduced the concept of threshold.

• 1710 – George Berkeley published Treatise Concerning the Principles of Human Knowledge, which claims that the outside world is composed solely of ideas.

• 1732 – Christian Wolff published Psychologia Empirica, followed in 1734 by Psychologia Rationalis, popularizing the term "psychology".

• 1739 – David Hume published A Treatise of Human Nature, claiming that all contents of mind are solely built from sense experiences.

• 1781 – Immanuel Kant published Critique of Pure Reason, rejecting Hume's extreme empiricism and proposing that there is more to knowledge than bare sense experience, distinguishing between "a posteriori" and "a priori" knowledge, the former being derived from perception, hence occurring after perception, and the latter being a property of thought, independent of experience and existing before experience.

• 1783 – Ferdinand Ueberwasser designated himself Professor of Empirical Psychology and Logic at the Old University of Münster; four years later, he published the comprehensive textbook Instructions for the regular study of empirical psychology for candidates of philosophy at the University of Münster which complemented his lectures on scientific psychology.

• 1798 – Immanuel Kant proposed the first dimensional model of consistent individual differences by mapping the four Hippocrates' temperament types into dimensions of emotionality and energetic arousal. These two dimensions later became an essential part of all temperament and personality models.

Nineteenth century

1800s

• c. 1800 – Franz Joseph Gall developed cranioscopy, the measurement of the skull to determine psychological characteristics, which was later renamed phrenology; it is now discredited.
• 1807 – Georg Wilhelm Friedrich Hegel published *Phenomenology of Spirit* (Mind), which describes his thesis-antithesis-synthesis dialectical method, according to which knowledge pushes forwards to greater certainty, and ultimately towards knowledge of the noumenal world.

• 1808 – Johann Christian Reil coined the term "psychiatry".

1810s

• 1812 – Benjamin Rush became one of the earliest advocates of humane treatment for the mentally ill with the publication of *Medical Inquiries and Observations Upon Diseases of the Mind*, the first American textbook on psychiatry.

1820s

• 1829 – John Stuart Mill's father James Mill published *Analysis of the Phenomena of the Human Mind* (2 vols.).

1840s

• 1840 – Frederick Augustus Rauch (1806–1841) published *Psychology, or a View of the Human Soul, including Anthropology*

• 1843 – Forbes Benignus Winslow (1810–1874) published *The Plea of Insanity in Criminal Cases*, helping establish the plea of insanity in criminal cases in Britain.

• 1844 – Søren Kierkegaard *The Concept of Anxiety*, the first exposition on anxiety.

• 1848 – Vermont railroad worker Phineas Gage had a 3-foot rod driven through his brain and jaw in an explosives accident, permanently changing his personality, revolutionizing scientific opinion about brain functions being localizable.

• 1849 – Søren Kierkegaard published *The Sickness Unto Death*.

1850s

• 1852 – Hermann Lotze published *Medical Psychology or Physiology of the Soul*.

• 1856 – Hermann Lotze began publishing his 3-volume magnum opus *Mikrokosmos* (1856–64), arguing that natural laws of inanimate objects apply to human minds and bodies but have the function of enabling us to aim for the values set by the deity, thus making room for aesthetics.

• 1859 – Pierre Briquet published *Traite Clinique et Therapeutique de L'Hysterie*. 
1860s

- 1860s – Franciscus Donders first used human reaction time to infer differences in cognitive processing.
- 1860 – Gustav Theodor Fechner published *Elements of Psychophysics*, founding the subject of psychophysics.
- 1861 – Paul Broca discovered an area in the left cerebral hemisphere that is important for speech production, now known as Broca's area, founding neuropsychology.
- 1869 – Francis Galton published *Hereditary Genius*, arguing for eugenics. He went on to found psychometrics, differential psychology, and the lexical hypothesis of personality.

1870s

- 1874 – Wilhelm Wundt published *Grundzüge der physiologischen Psychologie* (Principles of Physiological Psychology), the first textbook of experimental psychology.
- 1878 – G. Stanley Hall was awarded the first PhD on a psychological topic from Harvard (in philosophy).
- 1879 – Wilhelm Wundt opened the first experimental psychology laboratory at the University of Leipzig in Germany.

1880s

- 1882 – The Society for Psychical Research was founded in England.
- 1883 – G. Stanley Hall opened the first American experimental psychology research laboratory at Johns Hopkins University.
- 1883 – Emil Kraepelin published *Compendium der Psychiatrie*.
- 1884 – Ivan Pavlov began studying the digestive secretion of animals.
- 1884 – Tourette's Syndrome was first described.
- 1885 – Hermann Ebbinghaus published *Über das Gedächtnis* (On Memory), a groundbreaking work based on self-experiments, first describing the learning curve, forgetting curve, and spacing effect.
- 1886 – John Dewey published the first American textbook on psychology, titled *Psychology*.
- 1886 – Vladimir Bekhterev established the first laboratory of experimental psychology in Russia at Kazan University.
- 1886 – Sigmund Freud began private practice in Vienna.
- 1887 – Georg Elias Müller opened the 2nd German experimental psychology research laboratory in Göttingen.
1887 – George Trumbull Ladd (Yale) published *Elements of Physiological Psychology*, the first American textbook to include a substantial amount of information on the new experimental form of the discipline.

1887 – James McKeen Cattell founded an experimental psychology laboratory at the University of Pennsylvania, the 3rd in the United States.

1887 – G. Stanley Hall founded the *American Journal of Psychology* with a $500 contribution supplied by Robert Pearsall Smith of the American Society for Psychical Research.

1888 – William Lowe Bryan founded the United States' 4th experimental psychology laboratory at Indiana University.

1888 – Joseph Jastrow founded the United States' 5th experimental psychology laboratory at the University of Wisconsin–Madison.

1888 – G. Stanley Hall left Johns Hopkins for the presidency of the newly founded Clark University in Worcester, Mass.

1889 – James Mark Baldwin published the first volume of his *Handbook of Psychology*, titled "Sense and Intellect".

1889 – Edmund Sanford, a former student of G. Stanley Hall founded the United States' 6th experimental psychology laboratory at Clark University.

1889 – Edward Cowles founded the United States' 7th experimental psychology laboratory at the McLean Asylum in Waverley, Mass.

1889 – Harry Kirke Wolfe founded the United States' 8th experimental psychology laboratory at the University of Nebraska.

1890s

1890 – Christian von Ehrenfels published *On the Qualities of Form*, founding Gestalt psychology.

1890 – William James published *The Principles of Psychology*.

1890 – James Hayden Tufts founded the United States' 9th experimental psychology laboratory at the University of Michigan.

1890 – G. T. W. Patrick founded the United States' 10th experimental psychology laboratory at the University of Iowa.

1890 – James McKeen Cattell left Pennsylvania for Columbia University where he founded the United States' 11th experimental psychology laboratory.

1890 – James Mark Baldwin founded the first permanent experimental psychology laboratory in the British Empire at the University of Toronto.
1891 – Frank Angell founded the United States' 12th experimental psychology laboratory at the Cornell University.

1891 – Edvard Westermarck described the Westermarck effect, where people raised early in life in close domestic proximity later become desensitized to close sexual attraction, raising theories about the incest taboo.

1892 – G. Stanley Hall et al. founded the American Psychological Association (APA).

1892 – Edward Bradford Titchener took a professorship at Cornell University, replacing Frank Angell who left for Stanford University.

1892 – Edward Wheeler Scripture founded the experimental psychology laboratory at Yale University, the 19th in United States.

1892–1893 – Charles A. Strong opened the experimental psychology laboratory at the University of Chicago, the 20th in the United States, at which James Rowland Angell conducted the first experiments of functionalism in 1896.

1894 – Margaret Floy Washburn was the first woman to be granted a PhD in Psychology after she studied under E. B. Titchener at Cornell University.

1894 – James McKeen Cattell and James Mark Baldwin founded the Psychological Review to compete with Hall's American Journal of Psychology.


1896 – John Dewey published the paper The Reflex Arc Concept in Psychology, founding functionalism.

1896 – The first psychological clinic was opened at the University of Pennsylvania by Lightner Witmer; although often celebrated as marking the birth of clinical psychology, it was focused primarily on educational matters.

1896 – Edward B. Titchener, student of Wilhelm Wundt and originator of the terms "structuralism" and "functionalism" published An Outline of Psychology.

1897 – Havelock Ellis published Sexual Inversion.


1899 – On 4 November Sigmund Freud published The Interpretation of Dreams (Die Traumdeutung), marking the beginning of psychoanalysis, which attempts to deal with the Oedipal complex.
Twentieth century

1900s

- 1901 – Sigmund Freud published *The Psychopathology of Everyday Life*.
- 1903 – John B. Watson graduated from the University of Chicago; his dissertation on rat behavior has been described as a "classic of developmental psychobiology" by historian of psychology Donald Dewsbury.
- 1903 – Helen Thompson Woolley published her doctoral dissertation, *The Mental Traits of Sex*, for which she had conducted the first experimental test of sex differences.
- 1904 - Ivan Pavlov won the Nobel Prize for his studies of conditioning. This was the first Prize given for research adopted by psychologists.
- 1904 – Charles Spearman published the article *General Intelligence* in the *American Journal of Psychology*, introducing the $g$ factor theory of intelligence.
- 1905 – Alfred Binet and Theodore Simon created the Binet-Simon scale to identify students needing extra help, marking the beginning of standardized psychological testing.
- 1905 – Edward Thorndike published the law of effect.
- 1906 – The Journal of Abnormal Psychology was founded by Morton Prince, for which Boris Sidis was an associate editor and significant contributor.
- 1908 – Sigmund Freud published the paper *On the Sexual Theories of Children*, introducing the concept of penis envy; he also published the paper *'Civilized' Sexual Morality and Modern Nervous Illness*.
- 1908 – Wilfred Trotter published the first paper explaining the herd instinct.
- 1909 – Sigmund Freud lectured at Clark University, winning over the U.S. establishment.

1910s

- 1910 – Sigmund Freud founded the International Psychoanalytical Association (IPA), with Carl Jung as the first president, and Otto Rank as the first secretary.
- 1910 – Grace Helen Kent and J. Rosanoff published the Kent-Rosanoff Free Association Test
- 1910 – Boris Sidis opened the private Sidis Psychotherapeutic Institute at Maplewood Farms in Portsmouth, New Hampshire for the treatment of nervous patients using the latest scientific methods.
- 1911 – Alfred Adler left Freud's Psychoanalytic Group to form his own school of thought, accusing Freud of overemphasizing sexuality and basing his theory on his own childhood.
- 1911 – The American Psychoanalytic Association (APsaA) was founded.
• 1911 – William McDougall, founder of Hormic Psychology published *Body and Mind: A History and Defence of Animism*, claiming that there is an animating principle in Nature and that the mind guides evolution.

• 1912 – Max Wertheimer published *Experimental Studies of the Perception of Movement*, helping found Gestalt Psychology.

• 1913 – Carl Jung developed his own theories, which became known as Analytical Psychology.

• 1913 – Jacob L. Moreno pioneered group psychotherapy methods in Vienna, which emphasized spontaneity and interaction; they later became known as psychodrama and sociometry.

• 1913 – John B. Watson published *Psychology as the Behaviorist Views It*, sometimes known as "The Behaviorist Manifesto".

• 1913 – Hugo Münsterberg published *Psychology and Industrial Efficiency*, considered today as the first book on Industrial and Organizational Psychology.

• 1914 – Boris Sidis published *The Foundations of Normal and Abnormal Psychology*, where he provided the scientific foundation for the field of psychology, and detailed his theory of the moment consciousness.

• 1917 – Sigmund Freud published *Introduction to Psychoanalysis*.

1920s

• 1920 – John B. Watson and his assistant Rosalie Rayner conducted the Little Albert experiment, using classical conditioning to make a young boy afraid of white rats.

• 1921 – Sigmund Freud published *Group Psychology and the Analysis of the Ego*.

• 1921 – Jacob L. Moreno conducted the first large scale public psychodrama session at the Komediahaus in Vienna; he moved to New York in 1925.

• 1921 – Melanie Klein began to develop her technique of analyzing children.

• 1922 – Karen Horney began publishing a series of 14 papers (last in 1937) questioning Freud's theories on women, founding feminist psychology.

• 1922 – Boris Sidis published *Nervous Ills: Their Cause and a Cure*, a popularization of his work concerning the subconscious and the treatment of psychopathic disease.

• 1923 – Sigmund Freud published *The Ego and the Id*.

• 1924 – Jacob Robert Kantor founded interbehavioral psychology based on John Dewey's psychology and Albert Einstein's relativity theory.

• 1924 – Otto Rank published *The Trauma of Birth*, coining the term "pre-Oedipal". Freud had originally praised him for such, but changed his stance and as such caused their falling out.

• 1926 – Otto Rank gave the lecture "The Genesis of the Object Relation", founding object relations theory.
• 1927 – Ivan Pavlov published *Conditioned Reflexes*, containing his theory of classical conditioning.
• 1928 – Jean Piaget published *Judgment and Reasoning in the Child*.
• 1929 – Edwin Boring published *A History of Experimental Psychology*, pioneering the history of psychology.
• 1929 – Lev Vygotsky founded cultural-historical psychology.

1930s

• 1930 – Edwin Boring discussed the Boring figure.
• 1931 – Gordon Allport et al. published the Allport-Vernon-Lindzey Study of Values, which defines six major value types.
• 1932 – Journal of Personality founded as first personality psychology research periodical originally titled Character and Personality.
• 1933 – Pyotr Gannushkin published *Manifestations of Psychopathies*.
• 1933 – Clark L. Hull published *Hypnosis and Suggestibility*, proving that hypnosis is not sleep and founding the modern study of hypnosis.
• 1933 – Wilhelm Reich published *Character Analysis* and *The Mass Psychology of Fascism*.
• 1934 – Lev Vygotsky published *Thought and Language (Thinking and Speech)*.
• 1934 – Ruth Winifred Howard became the first African American woman to earn a PhD in psychology.
• 1935 – John Ridley Stroop developed a color-word task to demonstrate the interference of attention, the Stroop effect
• 1935 – Helen Flanders Dunbar published *Emotions and Bodily Changes: A Survey of Literature on Psychosomatic Interrelationships*; in 1942 she founded the American Psychosomatic Society (American Society for Research in Psychosomatic Problems), and was the first editor of the society's journal *Psychosomatic Medicine: Experimental and Clinical Studies*, founded in 1939.
• 1935 – Theodore Newcomb began the Bennington College Study, which ended in 1939, documenting liberalization of women students' political beliefs, along with the effects of proximity on acquaintance and attraction.
- 1936 – Kurt Lewin published *Principles of Topological Psychology*, containing Lewin's Equation \( B = f(P, E) \), meaning that behavior is a function of a person in their environment.
- 1936 – Wilhelm Reich published *The Sexual Revolution*.
- 1936 – Kenneth Spence published an analysis of discrimination learning in terms of gradients of excitation and inhibition, showing that mathematical deductions from a quantitative theory could generate interesting and empirically testable predictions.
- 1936 – The Psychometric Society was founded by Louis Leon Thurstone, who proposed dividing general intelligence into seven primary mental abilities (PMAs).
- 1939 – Alan Hodgkin and Andrew Huxley published a classic report in the journal *Nature* of the first recording of an action potential.
- 1939 – Neal E. Miller et al. published the frustration-aggression theory, which claims that aggression is the result of frustration of efforts to attain a goal.
- 1939 – David Wechsler developed the Wechsler-Bellevue Intelligence Scale.
- 1939 – On 1 September World War II began with the German invasion of Poland; on 20 September Adolf Hitler signed the Euthanasia Decree, written by psychologist Max de Crinis, resulting in the Aktion T4 euthanasia program; on 23 September Sigmund Freud committed physician-assisted suicide in London on the Jewish Day of Atonement; on 31 October his archrival Otto Rank died of a kidney infection in New York City after uttering the word "comical"; Wilhelm Reich fled to New York, coining the word orgone and building "orgone accumulators", which got him in trouble with the psychiatric establishment and the federal government.

**1940s**

- 1940 – Edwin Boring discussed the moon illusion.
- 1941 – B.F. Skinner and William Kaye Estes introduced the conditioned emotional response (CER)/conditioned fear response (CFR) paradigm via electric shocks given to rats.
- 1942 – Ludwig Binswanger founded existential therapy.
- 1942 – Carl Rogers published *Counseling and Psychotherapy*, suggesting that respect and a nonjudgmental approach to therapy is the foundation for effective treatment of mental health issues.
- 1943 – J. P. Guilford developed the Stanine (Standard Nine) test for the U.S. Air Force to evaluate pilots.
• 1943 – Clark L. Hull published *Principles of Behavior*, establishing animal-based learning and conditioning as the dominant learning theory.

• 1943 – Leo Kanner published *Autistic Disturbances of Affective Contact*, the first systematic description of autistic children.

• 1943 – Abraham Maslow published the paper *A Theory of Human Motivation*, describing Maslow's hierarchy of needs.

• 1944 – Zach Andrew and Cameron Peter published *Myer's Psychology Second Edition* where they revolutionized the approach of learned Psychology.

• 1945 – The *Journal of Clinical Psychology* was founded.

• 1946 – Kurt Lewin founded action research.

• 1946 – Stanley Smith Stevens published his levels of measurement theory.

• 1947 – Jerome Bruner published *Value and Need as Organizing Factors in Perception*, founding New Look Psychology, which challenges psychologists to study not just an organism's response to a stimulus but also its internal interpretation.

• 1947 – Kurt Lewin coined the term "group dynamics".

• 1947 Nikolai Bernstein summarized his research on the measurement of actions using his original devices that became a beginning of a new discipline of kinesiology.

• 1948 – Alfred Kinsey of Indiana University published *Sexual Behavior in the Human Male*.

• 1949 – The Boulder Conference outlined the scientist-practitioner model of clinical psychology.

• 1949 – Donald Hebb published *The Organization of Behavior: A Neuropsychological Theory*, in which he provided a detailed, testable theory of how the brain could support cognitive processes, revolutionizing neuropsychology and making McGill University a center of research.

• 1949 – David Wechsler published the Wechsler Intelligence Scale for Children (WISC).

1950s

• 1950 – Karen Horney summarized her ideas in her magnum opus *Neurosis and Human Growth: The Struggle Toward Self-Realization*.

• 1950 – Erik Erikson published *Childhood and Society*, in which he introduced his theory on the stages of psycho-social development and the concept of an identity crisis.

• 1950 – Rollo May published *The Meaning of Anxiety*.

• 1951 – Solomon Asch published the Asch conformity experiments, demonstrating the power of conformity in groups.
• 1951 – Morton Deutsch published *Interracial Housing: A Psychological Evaluation of a Social Experiment*, producing scientific evidence of the bad effects of segregated housing, helping to end it in the U.S.

• 1951 – Carl Rogers published his magnum opus *Client-Centered Therapy*.

• 1951 – Lee Cronbach published his measure of reliability, now known as Cronbach's alpha.

• 1952 – The Diagnostic and Statistical Manual of Mental Disorders (DSM) was published by the American Psychiatric Association (APA), marking the beginning of modern mental illness classification; it was revised in 1968, 1980/7, 1994, 2000 and 2013.

• 1952 – Hans Eysenck started a debate on psychotherapy with his critical review, claiming that psychotherapy had no documented effect, and psychoanalysis had negative effects.

• 1953 – Alfred Kinsey published *Sexual Behavior in the Human Female*.

• 1953 – Nathaniel Kleitman of the U. of Chicago discovered rapid eye movement sleep (REM), founding modern sleep research.

• 1953 – David McClelland proposed need theory.

• 1953 – B.F. Skinner outlined behavioral therapy, lending support for behavioral psychology via research in the literature.

• 1953 – The Code of Ethics for Psychologists was developed by the American Psychological Association (APA).

• 1953 – Harry Stack Sullivan published *The Interpersonal Theory of Psychiatry*, which holds that an individual's personality is formed by relationships.

• 1954 – Abraham Maslow helped to found humanistic psychology, later developing Maslow's hierarchy of needs.

• 1954 – Paul E. Meehl published a paper claiming that mechanical (formal algorithmic) methods of data combination outperform clinical (subjective informal) methods when used to arrive at a prediction of behavior.

• 1954 – James Olds and Peter Milner of McGill University discovered the brain reward system, involving the brain's pleasure center.

• 1954 – Julian Rotter published *Social Learning and Clinical Psychology*, founding social learning theory.

• 1954 – Herman Witkin published *Personality Through Perception*, which claims that personality can be revealed through differences in how people perceive their environment; he went on to develop the Rod and Frame Test (RFT).

• 1955 – Lee Cronbach published *Construct Validity in Psychological Tests*, popularizing the concept of construct validity.
1955 – J. P. Guilford developed the Structure of Intellect (SOI) theory, which divides human intelligence into 150 abilities along three dimensions, operations, content, and products; it is discredited by the 1990s.

1955 – George Kelly founded personal construct psychology.

1956 – George Armitage Miller published the paper The Magical Number Seven, Plus or Minus Two, in which he showed that there is a limit on the amount of information that can be memorized at one time.

1956 – Rollo May published Existence, promoting existential psychology.

1957 – Leon Festinger published his theory of cognitive dissonance.

1957 – Stanley Smith Stevens published Stevens' power law.

1957 – Eric Berne developed Transactional analysis (TA), in which psychiatry patients can be treated for emotional distresses by analyzing and altering their social transactions.


1958 – Harry Harlow gave the speech The Nature of Love, summarizing his isolation studies on infant monkeys and rejecting behavioristic and psychoanalytic theories of attachment.

1958 – Joseph Wolpe published his theory of reciprocal inhibition, leading to his theory of systematic desensitization for anxieties and phobias.

1959 – Viktor Frankl published the first English edition of Man's Search for Meaning [with a preface by Gordon Allport], which provided an existential account of his Holocaust experience and an overview of his system of existential analysis called Logotherapy.

1959 – Noam Chomsky published his review of B.F. Skinner's Verbal Behavior, an event seen as by many as the start of the cognitive revolution.

1959 – George Mandler and William Kessen published The Language of Psychology.

1959 – Lawrence Kohlberg wrote his doctoral dissertation, outlining Kohlberg's stages of moral development.


1961 – Albert Bandura published the Bobo doll experiment, a study of behavioral patterns of aggression.

1961 – Neal E. Miller proposed the use of biofeedback to control involuntary functions.

1962 – Wilfred Bion presented his unconventional theory of thinking.

1962 – Albert Ellis published Reason and Emotion in Psychotherapy, describing the theoretical foundations of his therapeutic system known as Rational Emotive Behavior Therapy.
1962 – George Armitage Miller published *Psychology, the Science of Mental Life*, rejecting the idea that psychology should study only behavior.


1962 – Stanley Schachter and Jerome Singer proposed the two-factor theory of emotion, which considers emotion to be a function of both cognitive factors and physiological arousal; "People search the immediate environment for emotionally relevant cues to label and interpret unexplained physiological arousal."

1962 – Silvan Tomkins published volume one (of two) of *Affect Imagery Consciousness*, presenting his affect theory.

1963 – Stanley Milgram published his study of obedience to authority, now known as the Milgram experiment.

1964 – Jean M. Mandler and George Mandler published *Thinking: From Association to Gestalt*.

1964 – Virginia Satir published *Conjoint Family Therapy*, the first of several books on family therapy, causing her to become known as the "Mother of Family Therapy."

1965 – Anna Freud published *Normality and Pathology in Childhood: Assessments of Development*, presenting the concept of developmental lines.

1965 – William Glasser published *Reality Therapy*, describing his psycho-therapeutic model and introducing his concept of control theory [later renamed to Choice Theory].


1966 – Nancy Bayley became the first woman to receive the APA Distinguished Scientific Contribution Award for her contribution in developmental psychology.

1966 – Konrad Lorenz published *On Aggression*, which discusses his hydraulic model of instinctive pressures.

1966 – Masters and Johnson published *Human Sexual Response*.

1966 – Julian Rotter published a paper proposing the Internal-External Locus of Control Scale (I-E Scale).

1967 – Aaron Beck published a psychological model of clinical depression, suggesting that thoughts play a significant role in the development and maintenance of depression.

1967 – Edward E. Jones and Victor Harris published a paper defining fundamental attribution error, underestimating the effect of the situation in explaining social behavior.

1967 – Ulric Neisser founded cognitive psychology.

1968 – George Cotzias developed the L-Dopa treatment for Parkinson's disease.
• 1968 – Mary Main published her hypothesis of a fourth attachment style in children, the insecure disorganized attachment style.
• 1968 – Walter Mischel published the paper "Personality and Assessment", criticizing Gordon Allport's works on trait assessment with the observation that a patient's behavior is not consistent across diverse situations but dependent on situational cues.
• 1968 – DSM-II was published by the American Psychiatric Association.
• 1968 – The first Doctor of Psychology (Psy. D.) professional degree program in Clinical Psychology was established in the Department of Psychology at the University of Illinois at Urbana–Champaign.
• 1969 – The California School of Professional Psychology was established as the first freestanding school of professional psychology.
• 1969 – The Journal of Transpersonal Psychology was founded by Abraham Maslow, Stanislav Grof, and Anthony Sutich.
• 1969 – John Bowlby published his attachment theory in the classic book Attachment and Loss (vol. 1 of 3).
• 1969 – Harry Harlow published his experiment on affection development in rhesus monkeys.
• 1969 – Joseph Wolpe published the Subjective Units of Distress (Disturbance) Scale (SUDS).
• 1969 – Elisabeth Kübler-Ross published On Death and Dying, presenting the Kübler-Ross model, commonly referred to as the five stages of grief.
• 1969 – The Association for Women in Psychology (AWP) was founded, with Joann Evansgardner as the first (temporary) president.

1970s

• 1970 – At an APA Town Hall Meeting, with the support of the Association for Women in Psychology, Phyllis Chesler and Nancy Henley prepared a statement on APA's obligations to women and demanded one million dollars in reparation for the damage psychology had perpetrated against women's minds and bodies.
• 1970 – APA Division 29 gives its first Distinguished Professional Award in Psychology and Psychotherapy to Eugene Gendlin.
• 1970 – Masters and Johnson published Human Sexual Inadequacy.
• 1971 – The Stanford prison experiment, conducted by Philip Zimbardo et al. at Stanford University, studied the human response to captivity; the experiment quickly got out of hand and was ended early.
• 1971 – Martin Shubik performed the dollar auction, illustrating irrational choices.
• 1971 – In Nov. John O'Keefe and Jonathan O. Dostrovsky announced their discovery of place cells in the hippocampus.
• 1971 – The Leibniz Institute for Psychology Information at the University of Trier was founded to publish the PSYNDEX database of references to psychology in the German-speaking world.

• 1972 – The Dunedin Multidisciplinary Health and Development Study commenced, a longitudinal study began, with 96% retention rate as of 2006, unprecedented for a longitudinal study, comparing to 20–40% dropout rates for other studies.


• 1972 – Endel Tulving first made the distinction between episodic and semantic memory.

• 1973 – Ernest Becker published *The Denial of Death*, siding with Otto Rank against Sigmund Freud, claiming that knowledge of one's mortality not sexuality is the basis of character.

• 1973 – Morton Deutsch published *The Resolution of Conflict*.

• 1973 – Vygotsky Circle neuropsychologist Alexander Luria published *The Working Brain*, a detailed description with great emphasis on rehabilitation of damage.

• 1973 – The Vail Conference of Graduate Educators in Psychology endorsed the scholar-practitioner training model, and approved the Doctor of Psychology (Psy. D) degree.

• 1973 – Division 35, later the Society for the Psychology of Women of the APA, was formed, with Elizabeth Douvan as the first president.

• 1973 – The Committee on Women in Psychology of the APA was formed, with Martha Mednick as its first chair.

• 1973 – The American Psychiatric Association declassified homosexuality as a mental disorder.

• 1973 – The Caucus of Gay, Lesbian, and Bisexual Members of the American Psychiatric Association was officially founded to advocate to the APA on LGBT mental health issues; in 1985 it changed its name to the Association of Gay and Lesbian Psychiatrists.

• 1973 – Nancy Friday published *My Secret Garden: Women’s Sexual Fantasies*

• 1973 – Timothy Leary published *Neurologic*, describing the eight-circuit model of consciousness.

• 1974 – Sandra Bem created the Bem Sex-Role Inventory.


• 1974 – Arnold Sameroff published *Reproductive Risk and the Continuum of Caretaking Causality*, introducing the transactional model of psychology, which became influential.

• 1974 – Alan Baddeley and Graham Hitch of the Univ. of York proposed Baddeley's model of working memory.
• 1974 – Elizabeth Loftus began publishing papers on the malleability of human memory, the misinformation effect, and false memory syndrome and its relation to recovered memory therapy.

• 1974 – The APA Task Force on Sex Bias and Sex-Role Stereotyping in Psychotherapeutic Practice was appointed.

• 1975 – Georgia Babladelis became the first editor of the Psychology of Women Quarterly.

• 1975 – George Mandler published Mind and Emotion.

• 1975 – Mary Wright became the first chair of the new Task Force on the Status of Women in Canadian Psychology.

• 1975 – Robert Zajonc published the confluence model, showing how birth order and family size affect IQ.

• 1975 – The first APA-sponsored Psychology of Women Conference was held.

• 1975 – The journal Sex Roles was founded.

• 1975 – The first review article on the psychology of women appeared in the women's studies journal Signs, by Mary Parlee.

• 1975 – The first article on the psychology of women was published in the Annual Review of Psychology.

• 1975 – The council of representatives of the American Psychological Association (APA) declassified homosexuality as a mental disorder.

• 1976 – Stanislav Grof founded the International Transpersonal Association to promote his transpersonal psychology.

• 1976 – Julian Jaynes published The Origin of Consciousness in the Breakdown of the Bicameral Mind, which coins the term bicameral mind for the brain of humans who lived before about 1,000 B.C.E., whose right side "speaks" in the name of a chieftain or god, and whose left side "listens" and takes orders.

• 1976 – Michael Posner published Chronometric Explorations of Mind, using the subtractive method of Franciscus Donders to study attention and memory.

• 1976 – The Psychology of Women Quarterly was founded.

• 1977 – Ernest Hilgard proposed the divided consciousness theory of hypnosis.

• 1977 – Alexander Thomas published Temperament and Development, a longitudinal study on the importance of temperament for the development of personality and behavioral problems.


• 1977 – Robert Plomin et al. proposed three major ways in which genes and environments act together to shape human behavior, coining the terms passive, active, and evocative gene-environment correlation.
1977 – Andrey Lichko published *Psychopathies and Accentuations of Character of Teenagers*.

1978 – Child psychologist Mary Ainsworth published her book *Patterns of Attachment* about her work on attachment theory and the Strange Situation Experiment (Protocol).

1978 – Paul Ekman published the Facial Action Coding System.

1978 – David Premack published the book *Does the Chimpanzee Have a Theory of Mind?*, about his research on mental abilities of monkeys, introducing the term theory of mind.

1978 – The term cognitive neuroscience was coined by Michael Gazzaniga and George Armitage Miller for the effort to understand how the brain represents mental events.


1978 – E.O. Wilson published *On Human Nature*, considered the first landmark text to deal with what would become evolutionary psychology.

1978 – The first Canadian Institute on Women and Psychology pre-convention conference was hosted at the Canadian Psychological Association by IGWAP (Interest Group on Women and Psychology).

1978 – The Caucus of Gay, Lesbian, and Bisexual Members of the American Psychiatric Association, (now known as the Association of Gay and Lesbian Psychiatrists) successfully petitioned the American Psychiatric Association (APA) to create a task force on lesbian and gay issues; it was elevated to a full standing committee in the APA in 1988.

1979 – Alice Miller published *The Drama of the Gifted Child*, the first of a series of books criticizing Freud and Jung for blaming the child for the sexual abuse of the parents, which she calls the "poisonous pedagogies".


1980s

1980 – Transgender people were officially classified by the American Psychiatric Association as having "gender identity disorder."

1980 – DSM-III was published by the American Psychiatric Association (APA).


1980 – Robert Zajonc published the paper "Feeling and Thinking: Preferences Need No Inferences", arguing that affective and cognitive systems are largely independent, and that affect is more powerful and important, reviving the study of emotion and affective processes.
- 1981 – Alan P. Bell, Martin S. Weinberg, and Sue Kiefer Hammersmith's *Sexual Preference* is published. The work later becomes one of the most frequently cited retrospective studies relating to sexual orientation.

- 1982 – Carol Gilligan published *In a Different Voice*, a work on feminist psychology.

- 1982 – The Caucus of Gay, Lesbian, and Bisexual Members of the American Psychiatric Association (APA) was recognized as a representative in the APA assembly, speaking directly on matters of special concern to lesbian and gay members.


- 1983 – The Caucus of Gay, Lesbian, and Bisexual Members of the American Psychiatric Association (APA) successfully petitioned the APA to create a task force on psychiatric aspects of AIDS, which ultimately led to the 1984 publication of two important APA volumes *Innovations in Psychotherapy with Homosexuals* and *Psychiatric Implications of Acquired Immune Deficiency Syndrome*.


- 1984 – Peter Saville published the OPQ Pentagon questionnaire, a psychological personality inventory measuring the five factor model.

- 1984 – Florence Denmark, Carolyn R. Payton, and Laurie Eyde received the first American Psychological Association (APA) Committee on Women in Psychology Leadership Awards.


- 1985 – Robert Sternberg proposed his triarchic theory of intelligence


- 1985 – Simon Baron-Cohen published *Does the Autistic Child Have a 'Theory of Mind'?* with Uta Frith and Alan Leslie, proposing that children with autism show social and communication difficulties as a result of a delay in the development of a theory of mind.

- 1985 – Costa & McRae published the NEO PI_R Five-Factor Personality Inventory, a 240-question measure of the five factor model


- 1986 – David Rumelhart and James McClelland published *Parallel Distributed Processing: Explorations in the Microstructure of Cognition*. 

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1987 – Roger Shepard published the universal law of generalization for psychological science.

1987 – The diagnostic category of "ego-dystonic homosexuality" was removed from the American Psychiatric Association's DSM with the publication of the DSM-III-R, though it still potentially remains in the DSM-IV under the category of "sexual disorder not otherwise specified" including "persistent and marked distress about one's sexual orientation".

1988 – Michael M. Merzenich et al. showed that sensory and motor maps in the cortex can be modified with experience, a process called neural plasticity.

1988 – Claude Steele proposed the theory of self-affirmation.


1990s

1990 – On 17 May the World Health Organization (WHO) declassified homosexuality as a mental disorder, launching the International Day Against Homophobia and Transphobia.

1990 – Leonard Berkowitz published the cognitive neoassociation model of aggressive behavior to cover the cases missed by the frustration-aggression hypothesis.


1991 – The first issue of *Feminism & Psychology* was published.

1991 – The American Psychoanalytic Association (APA) passed a resolution opposing "public or private discrimination" against homosexuals. It stopped short, however, of agreeing to open its training institutes to these individuals.

1992 – The American Psychoanalytic Association (APA) extended the provisions of its 1991 resolution (see above) to training candidates at its affiliated institutes.


1992 – Sandra Scarr published *Developmental Theories of the 1990s*, proposing that genes control experiences, and search and create environments.

- 1992 – The American Psychological Association (APA) selected behavioral genetics as one of two themes that best represented the past, present, and future of psychology.

- 1994 – DSM-IV was published by the American Psychiatric Association (APA).

- 1994 – Antonio Damasio published *Descartes’ Error*, presenting the somatic marker hypothesis (SMH) by which emotional processes can guide (or bias) behavior, particularly decision-making.


- 1994 – Michael Posner and Marcus Raichle published *Images of the Mind*, using positron emission tomography (PET) to localize brain cognitive functions.


- 1995 – Simon Baron-Cohen coined the term mental blindness to reflect the inability of children with autism to properly represent the mental states of others.

- 1996 – Giacomo Rizzolatti published his discovery of mirror neurons.

- 1996 – Amos Tversky defined ambiguity aversion, the idea that people do not like ambiguous choices, relating it to comparative ignorance.

- 1997 – The American Psychoanalytic Association (APsaA) became the first U.S. national mental health organization to support same-sex marriage.

- 1998 – Martin Seligman established Positive Psychology as his main theme when he became President of the American Psychological Association (APA).


**Twenty-first century**

**2000s**

- 2000 – Alan Baddeley updated his model of working memory from 1974 to include the *episodic buffer* as a third slave system alongside the *phonological loop* and the *visuo-spatial sketchpad*.

- 2000 – Max Velmans published *Understanding Consciousness*, arguing for reflexive monism.

- 2002 – Avshalom Caspi et al. presented a study that was the first to provide epidemiological evidence that a specific genotype moderates children's sensitivity to environmental insults.


• 2007 – George Mandler published *A History of Modern Experimental Psychology*

2010s

• 2010 – The draft of DSM-5 by the American Psychiatric Association (APA) was distributed for comment and critique.

• 2010 – Simon LeVay published *Gay, Straight, and the Reason Why*, which in 2012 received the Bullough Book Award for the most distinguished book written for the professional sexological community published in a given year.

• 2012 – In 2009 America’s professional association of endocrinologists established best practices for transgender children that included prescribing puberty-suppressing drugs to preteens followed by hormone therapy beginning at about age 16, and in 2012 the American Academy of Child and Adolescent Psychiatry echoed these recommendations.

• 2012 – The American Psychiatric Association issued official position statements supporting the care and civil rights of transgender and gender non-conforming individuals.

• 2013 – On 2 April U.S. President Barack Obama announced the 10-year BRAIN Initiative to map the activity of every neuron in the human brain.

• 2013 – DSM-5 was published by the American Psychiatric Association (APA). Among other things, it eliminated the term "gender identity disorder," which was considered stigmatizing, instead referring to "gender dysphoria," which focuses attention only on those who feel distressed by their gender identity.

• 2014 – Stanislas Dehaene, Giacomo Rizzolatti, and Trevor Robbins, were awarded the Brain Prize for their research on higher brain mechanisms underpinning literacy, numeracy, motivated behaviour, social cognition, and their disorders.

• 2014 – Brenda Milner, Marcus Raichle, and John O'Keefe received the Kavli Prize in Neuroscience for the discovery of specialized brain networks for memory and cognition.

• 2014 – John O'Keefe shared the Nobel Prize in Physiology or Medicine with May-Britt Moser and Edvard Moser for their discoveries of cells that constitute a positioning system in the brain.

• 2015 – The journal *Psychology Today* announced that it will no longer accept ads for gay conversion therapy, and is deleting medical practitioners who list such therapy in their professional profiles.

• 7 August 2015 – The American Psychological Association barred psychologists from participating in national security interrogations at sites violating international law.

• 27 August 2015 – A team led by Brian Nosek of the University of Virginia published an article in *Science* that revealed that only 39 of 100 studies published in major psychology journals could be replicated.


Genetics Timeline

Early timeline

- 1856–1863: Mendel studied the inheritance of traits between generations based on experiments involving garden pea plants. He deduced that there is a certain tangible essence that is passed on between generations from both parents. Mendel established the basic principles of inheritance, namely, the principles of dominance, independent assortment, and segregation.
- 1869: Friedrich Miescher discovers a weak acid in the nuclei of white blood cells that today we call DNA. In 1871 he isolated cell nuclei, separated the nucleic cells from bandages and then treated them with pepsin (an enzyme which breaks down proteins). From this, he recovered an acidic substance which he called "nuclein."
- 1880–1890: Walther Flemming, Eduard Strasburger, and Edouard Van Beneden elucidate chromosome distribution during cell division
- 1889: Richard Altmann purified protein free DNA. However, the nucleic acid was not as pure as he had assumed. It was determined later to contain a large amount of protein.
- 1889: Hugo de Vries postulates that "inheritance of specific traits in organisms comes in particles", naming such particles "(pan)genes"
- 1902: Archibald Garrod discovered inborn errors of metabolism. An explanation for epistasis is an important manifestation of Garrod's research, albeit indirectly. When Garrod studied alkaptonuria, a disorder that makes urine quickly turn black due to the presence of gentisate, he noticed that it was prevalent among populations whose parents were closely related.
- 1903: Walter Sutton and Theodor Boveri independently hypothesizes that chromosomes, which segregate in a Mendelian fashion, are hereditary units; see the chromosome theory. Boveri was studying sea urchins when he found that all the chromosomes in the sea urchins had to be present for proper embryonic development to take place. Sutton's work with grasshoppers showed that chromosomes occur in matched pairs of maternal and paternal chromosomes which separate during meiosis. He concluded that this could be "the physical basis of the Mendelian law of heredity."
- 1905: William Bateson coins the term "genetics" in a letter to Adam Sedgwick and at a meeting in 1906
- 1908: G.H. Hardy and Wilhelm Weinberg proposed the Hardy–Weinberg equilibrium model which describes the frequencies of alleles in the gene pool of a population, which are under certain specific conditions, as constant and at a state of equilibrium from generation to generation unless specific disturbing influences are introduced.
1910: Thomas Hunt Morgan shows that genes reside on chromosomes while determining the nature of sex-linked traits by studying *Drosophila melanogaster*. He determined that the white-eyed mutant was sex-linked based on Mendelian's principles of segregation and independent assortment.

1911: Alfred Sturtevant, one of Morgan's collaborators, invented the procedure of linkage mapping which is based on the frequency of crossing-over.

1913: Alfred Sturtevant makes the first genetic map, showing that chromosomes contain linearly arranged genes.

1918: Ronald Fisher publishes "The Correlation Between Relatives on the Supposition of Mendelian Inheritance" the modern synthesis of genetics and evolutionary biology starts. See population genetics.

1920: Lysenkoism Started, during Lysenkoism they stated that the hereditary factor are not only in the nucleus, but also in the cytoplasm, though they called it living protoplasm.

1923: Frederick Griffith studied bacterial transformation and observed that DNA carries genes responsible for pathogenicity.

1928: Frederick Griffith discovers that hereditary material from dead bacteria can be incorporated into live bacteria.

1930s–1950s: Joachim Hämmerling conducted experiments with *Acetabularia* in which he began to distinguish the contributions of the nucleus and the cytoplasm substances (later discovered to be DNA and mRNA, respectively) to cell morphogenesis and development.

1931: Crossing over is identified as the cause of recombination; the first cytological demonstration of this crossing over was performed by Barbara McClintock and Harriet Creighton.

1933: Jean Brachet, while studying virgin sea urchin eggs, suggested that DNA is found in cell nucleus and that RNA is present exclusively in the cytoplasm. At the time, "yeast nucleic acid" (RNA) was thought to occur only in plants, while "thymus nucleic acid" (DNA) only in animals. The latter was thought to be a tetramer, with the function of buffering cellular pH.

1933: Thomas Morgan received the Nobel prize for linkage mapping. His work elucidated the role played by the chromosome in heredity. Morgan voluntarily shared the prize money with his key collaborators, Calvin Bridges and Alfred Sturtevant.

1941: Edward Lawrie Tatum and George Wells Beadle show that genes code for proteins; see the original central dogma of genetics.

1943: Luria–Delbrück experiment: this experiment showed that genetic mutations conferring resistance to bacteriophage arise in the absence of selection, rather than being a response to selection.
The DNA era

- 1944: The Avery–MacLeod–McCarty experiment isolates DNA as the genetic material (at that time called transforming principle)
- 1947: Salvador Luria discovers reactivation of irradiated phage, stimulating numerous further studies of DNA repair processes in bacteriophage, and other organisms, including humans
- 1948: Barbara McClintock discovers transposons in maize
- 1950: Erwin Chargaff determined the pairing method of nitrogenous bases. Chargaff and his team studied the DNA from multiple organisms and found three things (also known as Chargaff's rules). First, the concentration of the pyrimidines (guanine and adenine) are always found in the same amount as one another. Second, the concentration of purines (cytosine and thymine) are also always the same. Lastly, Chargaff and his team found the proportion of pyrimidines and purines correspond each other.
- 1952: The Hershey–Chase experiment proves the genetic information of phages (and, by implication, all other organisms) to be DNA.
- 1952: an X-ray diffraction image of DNA was taken by Raymond Gosling in May 1952, a student supervised by Rosalind Franklin
- 1953: DNA structure is resolved to be a double helix by Rosalind Franklin, James Watson and Francis Crick
- 1955: Alexander R. Todd determined the chemical makeup of nitrogenous bases. Todd also successfully synthesized adenosine triphosphate (ATP) and flavin adenine dinucleotide (FAD). He was awarded the Nobel prize in Chemistry in 1957 for his contributions in the scientific knowledge of nucleotides and nucleotide co-enzymes.
- 1955: Joe Hin Tjio, while working in Albert Levan's lab, determined the number of chromosomes in humans to be of 46. Tjio was attempting to refine an established technique to separate chromosomes onto glass slides by conducting a study of human embryonic lung tissue, when he saw that there were 46 chromosomes rather than 48. This revolutionized the world of cytogenetics.
- 1957: Arthur Kornberg with Severo Ochoa synthesized DNA in a test tube after discovering the means by which DNA is duplicated. DNA polymerase 1 established requirements for in vitro synthesis of DNA. Kornberg and Ochoa were awarded the Nobel Prize in 1959 for this work.
- 1957/1958: Robert W. Holley, Marshall Nirenberg, Har Gobind Khorana proposed the nucleotide sequence of the tRNA molecule. Francis Crick had proposed the requirement of some kind of adapter molecule and it was soon identified by Holey, Nirenberg and Khorana. These scientists help explain the link between a messenger RNA nucleotide sequence and a polypeptide sequence. In the experiment, they purified tRNAs from yeast cells and were awarded the Nobel prize in 1968.
- 1958: The Meselson–Stahl experiment demonstrates that DNA is semiconservatively replicated.
• 1960: Jacob and collaborators discover the operon, a group of genes whose expression is coordinated by an operator.

• 1961: Francis Crick and Sydney Brenner discovered frame shift mutations. In the experiment, proflavin-induced mutations of the T4 bacteriophage gene (rIIB) were isolated. Proflavin causes mutations by inserting itself between DNA bases, typically resulting in insertion or deletion of a single base pair. The mutants could not produce functional rIIB protein. These mutations were used to demonstrate that three sequential bases of the rIIB gene's DNA specify each successive amino acid of the encoded protein. Thus the genetic code is a triplet code, where each triplet (called a codon) specifies a particular amino acid.

• 1961: Sydney Brenner, Francois Jacob and Matthew Meselson identified the function of messenger RNA.


• 1964: Howard Temin showed using RNA viruses that the direction of DNA to RNA transcription can be reversed

• 1964: Lysenkoism Ended

• 1966: Marshall W. Nirenberg, Philip Leder, Har Gobind Khorana cracked the genetic code by using RNA homopolymer and heteropolymer experiments, through which they figured out which triplets of RNA were translated into what amino acids in yeast cells.

• 1969: Molecular hybridization of radioactive DNA to the DNA of cytological preparation. by Pardue, M. L. and Gall, J. G.

• 1970: Restriction enzymes were discovered in studies of a bacterium, Haemophilus influenzae, by Hamilton O. Smith and Daniel Nathans, enabling scientists to cut and paste DNA.

• 1972: Stanley Norman Cohen and Herbert Boyer at UCSF and Stanford University constructed Recombinant DNA which can be formed by using restriction Endonuclease to cleave the DNA and DNA ligase to reattach the "sticky ends" into a bacterial plasmid.

**The genomics era**

• 1972: Walter Fiers and his team were the first to determine the sequence of a gene: the gene for bacteriophage MS2 coat protein.

• 1976: Walter Fiers and his team determine the complete nucleotide-sequence of bacteriophage MS2-RNA

• 1976: Yeast genes expressed in E. coli for the first time.

• 1977: DNA is sequenced for the first time by Fred Sanger, Walter Gilbert, and Allan Maxam working independently. Sanger's lab sequence the entire genome of bacteriophage Φ-X174.
In the late 1970s: nonisotopic methods of nucleic acid labeling were developed. The subsequent improvements in the detection of reporter molecules using immunocytochemistry and immunofluorescence, in conjunction with advances in fluorescence microscopy and image analysis, have made the technique safer, faster and reliable.

1980: Paul Berg, Walter Gilbert and Frederick Sanger developed methods of mapping the structure of DNA. In 1972, recombinant DNA molecules were produced in Paul Berg's Stanford University laboratory. Berg was awarded the 1980 Nobel Prize in Chemistry for constructing recombinant DNA molecules that contained phage lambda genes inserted into the small circular DNA mol.

1980: Stanley Norman Cohen and Herbert Boyer received first U.S. patent for gene cloning, by proving the successful outcome of cloning a plasmid and expressing a foreign gene in bacteria to produce a "protein foreign to a unicellular organism." These two scientist were able to replicate proteins such as HGH, Erythropoietin and Insulin. The patent earned about $300 million in licensing royalties for Stanford.

1982: The U.S. Food and Drug Administration (FDA) approved the release of the first genetically engineered human insulin, originally biosynthesized using recombination DNA methods by Genentech in 1978. Once approved, the cloning process lead to mass production of humulin (under license by Eli Lilly & Co.).

1983: Kary Banks Mullis invents the polymerase chain reaction enabling the easy amplification of DNA.

1983: Barbara McClintock was awarded the Nobel Prize in Physiology or Medicine for her discovery of mobile genetic elements. McClintock studied transposon-mediated mutation and chromosome breakage in maize and published her first report in 1948 on transposable elements or transposons. She found that transposons were widely observed in corn, although her ideas weren't widely granted attention until the 1960s and 1970s when the same phenomenon was discovered in bacteria and Drosophila melanogaster.

1985: Alec Jeffreys announced DNA fingerprinting method. Jeffreys was studying DNA variation and the evolution of gene families in order to understand disease causing genes. In an attempt to develop a process to isolate many mini-satellites at once using chemical probes, Jeffreys took x-ray films of the DNA for examination and noticed that mini-satellite regions differ greatly from one person to another. In a DNA fingerprinting technique, a DNA sample is digested by treatment with specific nucleases or Restriction endonuclease and then the fragments are separated by electrophoresis producing a template distinct to each individual banding pattern of the gel.

1986: Jeremy Nathans found genes for color vision and color blindness, working with David Hogness, Douglas Vollrath and Ron Davis as they were studying the complexity of the retina.

1987: Yoshizumi Ishino accidentally discovers and describes part of a DNA sequence which later will be called CRISPR.
- 1989: Thomas Cech discovered that RNA can catalyze chemical reactions, making for one of the most important breakthroughs in molecular genetics, because it elucidates the true function of poorly understood segments of DNA.

- 1989: The human gene that encodes the CFTR protein was sequenced by Francis Collins and Lap-Chee Tsui. Defects in this gene cause cystic fibrosis.

- 1992: American and British scientists unveiled a technique for testing embryos in-vitro (Amniocentesis) for genetic abnormalities such as Cystic fibrosis and Hemophilia.

- 1993: Phillip Allen Sharp and Richard Roberts awarded the Nobel Prize for the discovery that genes in DNA are made up of introns and exons. According to their findings not all the nucleotides on the RNA strand (product of DNA transcription) are used in the translation process. The intervening sequences in the RNA strand are first spliced out so that only the RNA segment left behind after splicing would be translated to polypeptides.

- 1994: The first breast cancer gene is discovered. BRCA I, was discovered by researchers at the King laboratory at UC Berkeley in 1990 but was first cloned in 1994. BRCA II, the second key gene in the manifestation of breast cancer was discovered later in 1994 by Professor Michael Stratton and Dr. Richard Wooster.

- 1995: The genome of bacterium *Haemophilus influenzae* is the first genome of a free living organism to be sequenced

- 1996: *Saccharomyces cerevisiae*, a yeast species, is the first eukaryote genome sequence to be released

- 1996: Alexander Rich discovered the Z-DNA, a type of DNA which is in a transient state, that is in some cases associated with DNA transcription. The Z-DNA form is more likely to occur in regions of DNA rich in cytosine and guanine with high salt concentrations.

- 1997: Dolly the sheep was cloned by Ian Wilmut and colleagues from the Roslin Institute in Scotland.

- 1998: The first genome sequence for a multicellular eukaryote, *Caenorhabditis elegans*, is released

- 2000: The full genome sequence of *Drosophila melanogaster* is completed.

- 2001: First draft sequences of the human genome are released simultaneously by the Human Genome Project and Celera Genomics.

- 2001: Francisco Mojica and Rudd Jansen propose the acronym CRISPR to describe a family of bacterial DNA sequences that can be used to specifically change genes within organisms.

- 2003 (14 April): Successful completion of Human Genome Project with 99% of the genome sequenced to a 99.99% accuracy

- 2003: Paul Hebert introduces the standardisation of molecular species identification and coins the term 'DNA Barcoding', proposing Cytochrome Oxidase 1 (CO1) as the DNA Barcode for Animals.
• 2004: Merck introduced a vaccine for Human Papillomavirus which promised to protect women against infection with HPV 16 and 18, which inactivates tumor suppressor genes and together cause 70% of cervical cancers.

• 2007: Michael Worobey traced the evolutionary origins of HIV by analyzing its genetic mutations, which revealed that HIV infections had occurred in the United States as early as the 1960s.

• 2007: Timothy Ray Brown becomes the first person cured from HIV/AIDS through a Hematopoietic stem cell transplantation.

• 2007: The Barcode of Life Data System (BOLD) is set up as an international reference library for molecular species identification (www.barcodinglife.org).

• 2008: Houston-based Introgen developed Advexin (FDA Approval pending), the first gene therapy for cancer and Li-Fraumeni syndrome, utilizing a form of Adenovirus to carry a replacement gene coding for the p53 protein.

• 2009: The Consortium for the Barcode of Life Project (CBoL) Plant Working Group propose rbcL and matK as the duel barcode for land plants.

• 2010: transcription activator-like effector nucleases (or TALENs) are first used to cut specific sequences of DNA.

• 2011: Fungal Barcoding Consortium propose Internal Transcribed Spacer region (ITS) as the Universal DNA Barcode for Fungi.

• 2012: The flora of Wales is completely barcoded, and reference specimens stored in the BOLD systems database, by the National Botanic Garden of Wales.

• 2016: A genome is sequenced in outer space for the first time, with NASA astronaut Kate Rubins using a MinION device aboard the International Space Station.

**Timeline of nuclear weapons development**

**Before 1930**

• 1895 – Wilhelm Konrad Röntgen discovers X-rays at the University of Würzburg.

• 1896 – Henri Becquerel discovers that uranium emits radiation at the National Museum of Natural History in Paris.

• 1898 – J.J. Thomson observes the photoelectric effect.

• 1900 – Max Planck theorizes that matter can only absorb energy in fixed quanta.

• 1904 – Frederick Soddy first proposes a bomb powered by nuclear fission to the Royal Engineers.
• 1905 – Albert Einstein develops the theory of relativity equating energy and matter.
• 1911 – Ernest Rutherford discovers that the majority of the energy in an atom is contained in the nucleus through experiments at the University of Manchester.
• 1912 – J.J. Thomson discovers isotopes through experiments with neon.
• 1914 – H.G. Wells writes *The World Set Free*, a science fiction novel postulating a world war in 1956 pitting the United Kingdom and France against Germany and Austria-Hungary. Inspired by the research of Rutherford, Sir William Ramsay, and Frederick Soddy, the novel predicts the development of nuclear weapons, and features a uranium-based hand grenade that does not extinguish once detonated.
• 1920 – Rutherford postulates the existence of a neutral particle in the atomic nucleus at a Bakerian Lecture in London.
• 1924 – Writing for *The Pall Mall Gazette*, Winston Churchill speculates "Might a bomb no bigger than an orange be found to possess a secret power to destroy a whole block of buildings – nay to concentrate the force of a thousand tons of cordite and blast a township at a stroke?"

1930–1940

• 1932 – James Chadwick discovers the neutron, leading to experiments in which elements are bombarded with the new particle.
• 1933 – Leó Szilárd realizes the concept of the nuclear chain reaction, although no such reaction was known at the time. He invented the idea of an atomic bomb in 1933 while crossing a London street in Russell Square. He patented it in 1934. (British patent 630,726)
• 1934 – Enrico Fermi conducts experiments in which he exposes uranium and thorium to neutrons to create distinct new substances. Although he is unaware at the time, he creates the first synthetic elements, the transuranium elements.
• 1938 – Fermi is awarded the Nobel Prize in Physics for his achievements, and flees from Fascist Italy to the United States due to the racial laws ratified under pressure from Nazi Germany.
• 1938 – December – The German chemists Otto Hahn and Fritz Strassman detect barium after bombarding uranium with neutrons. This is correctly interpreted by Lise Meitner and her nephew Otto Robert Frisch as nuclear fission.
• 1939 – January – Otto Robert Frisch experimentally confirms Otto Hahn and Fritz Strassman's discovery of nuclear fission. Frisch goes to Copenhagen to share the discovery with his Niels Bohr, who in turn reports the discovery to his American colleagues. Bohr and John Archibald Wheeler determine later that year through chain-reaction experiments at Princeton University that uranium-235 could produce a nuclear explosion.
• 1939 – April – Nazi Germany begins the German nuclear energy project.
1939 – September 1 – World War II begins after the invasion and subsequent partition of Poland between Nazi Germany and the Soviet Union.

1939 – October – U.S. President Franklin D. Roosevelt receives the Einstein–Szilárd letter and authorizes the creation of the Advisory Committee on Uranium. The Uranium Committee has its first meeting on October 21, and $6,000 was budgeted for conducting neutron experiments.

1940–1950

1940 – April – The MAUD Committee (Military Application of Uranium Detonation) is established by Henry Tizard and the British Ministry of Aircraft Production to investigate feasibility of an atomic bomb.

1940 – May – The paper which Dr. Yoshio Nishina of Nuclear Research Laboratory of Riken and Professor of Chemical Institute, Faculty of Science, Imperial University of Tokyo, Kenjiro Kimura presented to Physical Review, showed that they had produced neptunium-237 by exposing triuranium octoxide to fast neutrons for more than 50 hours.

1940 – July – The paper explaining that Dr. Yoshio Nishina and Kenjiro Kimura discovered symmetric fission on the previously described test appeared in Nature. The LibreTexts libraries based upon work supported by the National Science Foundation says, "Multiple combinations of symmetric fission products are possible for fission chain reactions." And, again, it as fission product yield, is known that the higher the energy of the state that undergoes nuclear fission is more likely a symmetric fission.

1940 – July – The Soviet Academy of Sciences starts a committee to investigate the development of a nuclear bomb.

1941 – February – Plutonium discovered by Glenn Seaborg and Arthur Wahl at the University of California, Berkeley.

1941 – May – A review committee postulates that the United States will not isolate enough uranium-235 to build an atomic bomb until 1945.

1941 – June – President Roosevelt forms the Office of Scientific Research and Development under Vannevar Bush.

1941 – June 15 – The MAUD Committee approves a report that a uranium bomb could be built.

1941 – June 22 – Operation Barbarossa, the 1941 German invasion of the Soviet Union, begins. Soviet nuclear research is subsequently delayed.

1941 – October – President Roosevelt receives MAUD report on the design and costs to develop a nuclear weapon. Roosevelt approves project to confirm MAUD's finding.
1941 – December – The United States enters World War II after the Pearl Harbor attack and the German declaration of war against the United States, leading to an influx in funding and research for atomic weapons.

1942 – The United Kingdom opts to support the United States' efforts to build a bomb rather than to pursue its own nuclear weapons program due to wartime economic damage, and allows the Tube Alloys programme to be subsumed into the American project.

1942 – April – Joseph Stalin was first informed of the efforts to develop nuclear weapons based on a letter sent to him by Georgii Flerov pointing out that there was nothing being published on nuclear fission since its discovery, and the prominent physicists likely involved had not been publishing at all. This urged the Soviet Union to start a nuclear weapons program.

1942 – July – The Heereswaffenamt (HWA, Army Ordance Office) relinquishes control of the German nuclear energy project to the Reichsforschungsrat (RFR, Reich Research Council), essentially making it only a research project with objectives far short of making a weapon.

1942 – July through September – A summer conference at University of California, Berkeley is convened by physicist Robert Oppenheimer and discusses the design of a fission bomb. Edward Teller introduces the "Super" hydrogen bomb as a major discussion point.

1942 – August through November – The Manhattan Project is established by the U.S. Army Corps of Engineers under command of General Leslie Groves. "Site X" is chosen in Tennessee, for isotopic separation of uranium-235 from natural uranium, and will later become Oak Ridge National Laboratory. Hanford Site is chosen in Washington, for making plutonium in nuclear reactors. "Site Y" is chosen by Groves and Dr. J. Robert Oppenheimer near Albuquerque, New Mexico, for bomb design and manufacture, and will later become Los Alamos National Laboratory.

1942 – December 2 – Enrico Fermi and his team achieve the first controlled nuclear reaction at Chicago Pile-1 constructed at the University of Chicago in a squash court underneath Stagg Field.

1943 – Laboratory No. 2 is established to pursue nuclear weapons research under Igor Kurchatov.

1943 – March – The Japanese Committee on Research in the Application of Nuclear Physics, chaired by Yoshio Nishina concludes in a report that while an atomic bomb was feasible, it would be unlikely to produce one during the war. Japan then concentrated on research into radar.

1943 – April – Introductory lectures begin at Los Alamos, which later are compiled into The Los Alamos Primer.

1943 – August – The Quebec Agreement is signed by President Roosevelt and British Prime Minister Winston Churchill. A team of British scientists join the Manhattan Project, including Klaus Fuchs.

1944 – April – Emilio Segrè discovers that the spontaneous fission rate of plutonium is too high to be used in a gun-type fission weapon. Leads to change in priority to the design of an implosion-type nuclear weapon. The calutrons at the Y-12 uranium enrichment plant are activated.
- **1944** – July – Sergei Korolev is released from a Gulag and assigned for rocket development.
- **1944** – September – The first plutonium reactor is activated in Hanford, but shuts itself off immediately.
- **1944** – September 8 – The Wehrmacht launches the V-2 rocket, the first ballistic missile and the template for later American and Soviet nuclear missile designs. It is based on the designs of Wernher von Braun.
- **1945** – March 10 – A Japanese Fu-Go balloon bomb nearly knocks out electrical power to the Hanford plant.
- **1945** – April 12 – U.S. Vice President Harry S. Truman is inaugurated President after the death of Franklin D. Roosevelt, and is informed about the Manhattan Project by War Secretary Henry L. Stimson.
- **1945** – May 7 – Nazi Germany formally surrenders to the Allied Powers, ending World War II in Europe.
- **1945** – May – The United States captures a number of important German rocket scientists, including Wernher von Braun, for work on American missile programs through Operation Paperclip. Von Braun is eventually assigned to the Army Ballistic Missile Agency at the Redstone Arsenal in Huntsville, Alabama.
- **1945** – June – The Office of Military Government, United States hands over Nordhausen, including the Mittelwerk factory where the V-2 rocket was constructed, to the Group of Soviet Occupation Forces in Germany. Soviet forces find documents and equipment from the factory and recruit Helmut Gröttrup.
- **1945** – July 16 – The first nuclear explosion, the Trinity test of an implosion-type plutonium-based nuclear weapon known as "the gadget", near Alamogordo, New Mexico.
- **1945** – July 22 – Truman alludes to Stalin about having successfully detonated an atomic bomb at the Potsdam Conference.
- **1945** – August 6 – "Little Boy", a gun-type uranium-235 weapon, is dropped on Hiroshima, Japan.
- **1945** – August 9 – "Fat Man", an implosion-type plutonium-239 weapon, is dropped on Nagasaki, Japan.
- **1945** – August – The Smyth Report is published detailing the efforts of the Manhattan Project.
- **1945** – August – Surrender of Japan to the Allied Powers.
- **1945** – August – The Soviet atomic bomb project is accelerated under a Special Commission chaired by Lavrentiy Beria. The program would be heavily reliant on espionage on the Manhattan Project, especially by Fuchs and Theodore A. Hall.
- **1945** – October 18 – The Atomic Energy Commission (CEA) is established in France by French President Charles de Gaulle to investigate military uses of atomic energy.
- **1946** – March 26 – The Strategic Air Command is established in the U.S. Army Air Forces for command and control of nuclear weapons.
1946 – June – First meeting of the United Nations Atomic Energy Commission, which was established by the first resolution of the U.N. General Assembly, is held.


1946 – August – The Convair B-36 Peacemaker is introduced as the first purpose-built nuclear bomber.

1946 – December 25 – The Soviet Union activates the F-1 pile in Moscow, producing the first controlled nuclear reaction in Europe.

1947 – The RTV-A-2 Hiroc, the first design of an intercontinental ballistic missile, is cancelled by the United States.

1947 – A steppe near Semipalatinsk, Kazakh SSR is selected by Beria as the Soviet Union's nuclear test site.


1947 – August 15 – The Partition of India between the Dominion of India and the Dominion of Pakistan occurs.


1948 – Andrei Sakharov proposes the first design for a Soviet hydrogen bomb.

1948 – Indian Prime Minister Jawaharlal Nehru ratifies an act establishing the Atomic Energy Commission of India chaired by Homi J. Bhabha.

1948 – September – The Soviet Union launches its first ballistic missile, a reverse-engineered version of the V-2 rocket later renamed the R-1 rocket.

1948 – The United States transfers nuclear-capable B-29 bombers to Europe during the Berlin Blockade.

1949 – August – The Soviet Union conducts its first atomic test, First Lightning (nicknamed Joe 1 by the Americans).

1949 – September through December – Debate occurs within the Truman administration over whether to authorize the development of a hydrogen bomb. Although the AEC General Advisory Committee chaired by Oppenheimer condemns the idea, the bomb is encouraged by the Department of State, the Department of Defense, the Joint Chiefs of Staff, the Joint Committee on Atomic Energy, and the National Security Council.


1949 – The U.S. Department of Defense prepares Operation Dropshot, a contingency plan for a nuclear and conventional war against the Soviet Union.

1949 – Following the Berlin Blockade and the articulation of the Truman Doctrine, the North Atlantic Treaty is ratified by 22 signatories in Western Europe and North America, including the United States,
creating the collective security alliance NATO. The Treaty places its members under an American "nuclear umbrella" against a Soviet attack and provides the basis for nuclear weapons sharing agreements with Italy, the Netherlands, and Belgium.

1950–1960

- **1950** – January 31 – President Harry S. Truman authorizes the development of the hydrogen bomb.
- **1950** – April 7 – The National Security Council issues its classified NSC 68 policy paper advocating for the United States to expand its conventional and nuclear arms in response to the Cold War and the decline of former great powers such as the United Kingdom, France, and Japan. President Truman takes the paper's advice and triples U.S. military expenditures over the course of three years.
- **1950** – Klaus Fuchs and Julius and Ethel Rosenberg are arrested in the United States for leaking atomic secrets to the Soviet Union.
- **1950** – December – General Douglas MacArthur of the UN Command requests 34 nuclear bombs after China intervenes in the Korean War.
- **1951** – January 12 – In response to the threat of a Soviet nuclear attack, President Truman creates the Federal Civil Defense Administration. The FCDA is succeeded by the Federal Civil Defense Authority in 1972, which is in turn succeeded by the Federal Emergency Management Agency in 1979.
- **1951** – President Truman establishes the CONELRAD emergency broadcasting system to alert the United States to an enemy attack. The system is later succeeded by the Emergency Broadcast System in 1963 and the Emergency Alert System in 1997.
- **1951** – The United States opens the Nevada Test Site for nuclear weapons tests.
- **1951** – MacArthur, with the approval of the Commander-in-Chief of the Strategic Air Command Curtis LeMay and South Korean President Syngman Rhee, pressures the government for the use of nuclear weapons against China. He is overruled and it becomes a factor in President Truman's relief of General Douglas MacArthur.
- **1951** – China and the Soviet Union sign an agreement whereby China would supply uranium ore in exchange for technical assistance in producing nuclear weapons.
- **1952** – October – The United Kingdom conducts Operation Hurricane, the first test of a British nuclear weapon. The plutonium implosion-type nuclear weapon was detonated in a lagoon between the Montebello Islands, Western Australia.
- **1952** – Greece and Turkey join NATO, allowing them to participate in nuclear sharing programs.
- **1952** – November 1 – The United States test the first fusion bomb, *Ivy Mike*.
- **1953** – The first nuclear-tipped rockets are deployed by the United States. The MGR-1 Honest John is such as example.
• 1953 – February – President Eisenhower considers using nuclear weapons when negotiations on the Korean Armistice Agreement stalled.

• 1953 – August 12 – The Soviet Union conducts its first test of a hydrogen bomb, nicknamed Joe 4 by the Americans. Unlike the American hydrogen bomb, the Soviet RDS-4 design is deliverable.

• 1953 – August 20 – The United States test-fires the PGM-11 Redstone rocket, its first ballistic missile.

• 1953 – October 30 – The United States formalizes its New Look foreign policy through NSC 162/2, emphasizing the United States' superiority in nuclear and conventional forces.

• 1953 – December 8 – U.S. President Dwight D. Eisenhower announces the Atoms for Peace program at the U.N. General Assembly.

• 1954 – British English Electric Canberra bombers of the Royal Air Force are outfitted with atomic bombs.

• 1954 – The Lockheed EC-121 Warning Star is introduced as the United States' primary airborne early warning and control aircraft.

• 1954 – January 12 – U.S. Secretary of State John Foster Dulles articulates a policy of "massive retaliation."

• 1954 – March 1 – The United States detonates its first deliverable thermonuclear weapons at Bikini Atoll, Marshall Islands. One device had a yield almost three times as large as expected, leading to the worst radiological disaster in US history.

• 1954 – June 17 – Prime Minister Churchill decides to begin the British hydrogen bomb programme, and Minister of Defense Harold Macmillan publicly announces it in the next year on February 17.

• 1954 – September – The First Taiwan Strait Crisis begins when Communist China begins an artillery bombardment of the Kuomintang-held islands of Kinmen and the Matsu Islands, resulting in the United States concluding a Mutual Defense Treaty with Taiwan and contemplating a nuclear attack against the Mainland. Although the crisis ends after China's participation in the Bandung Conference, the Soviet Union agrees to assist China with nuclear weapons development as a result.

• 1954 – December 26 – The French nuclear weapons program is secretly established by Prime Minister Pierre Mendès France.

• 1955 – January 15 – China begins Project-596 under Marshal Nie Rongzheng with the approval of Mao Zedong. The Third Ministry of Machine Building, a predecessor of the China National Nuclear Corporation, is created to oversee the project.

• 1955 – February – The Boeing B-52 Stratofortress replaces the B-36 as the U.S. Air Force's primary strategic nuclear bomber.

• 1955 – India purchases a PUREX reactor from Canada and the United States, and constructs the Bhabha Atomic Research Centre at Trombay.

• 1955 – West Germany joins NATO, allowing it to participate in nuclear sharing.
1955 – The Soviet Union introduces a modified version of the Myasishchev M-4 bomber capable of striking targets in continental North America.

1955 – February – The President's Science Advisory Committee recommends that the United States make missile production a national priority.

1956 – The Tupolev Tu-95, the primary intercontinental strategic bomber of the Soviet Air Forces, enters service.

1956 – Development on the Avro Blue Steel air-to-surface missile for the British "V-bomber" fleet begins.

1956 – The nuclear-capable PGM-19 Jupiter medium-range ballistic missile is created from the Redstone rocket.

1956 – October–November – The Soviet Union threatens nuclear strikes against the United Kingdom and France during the Suez Crisis.

1956 – November 30 – France establishes a secret committee for the Military Applications of Atomic Energy under Pierre Guillaumat and Yves Rocard. It establishes a secret protocol between the CEA and the Ministry of Defence for procuring weapons material.

1956 – The Pakistan Atomic Energy Commission is established. This commission is responsible for the development of both the nuclear reactors and nuclear weapons of Pakistan.

1957 – Israel purchases a nuclear reactor from France, which is built at Dimona in the Negev. By this time it has already started a weapons program under Israeli Prime Minister David Ben-Gurion, Defense Minister Shimon Peres, and Ernst David Bergmann.


1957 – August 26 – The Soviet Union announces the successful test of an intercontinental ballistic missile, the R-7 Semyorka, capable of flying "into any part of the world."

1957 – October 4 – The Sputnik 1, the first artificial satellite, is launched using an modified version of the Soviet Union's ICBM, beginning the Space Race.

1957 – In response to the new threat of Soviet ICBMs, the U.S. Army accelerates production on the Nike Zeus missile, an anti-ballistic missile designed to intercept ICBMs in mid-air.

1957 – Operation Antler, the final British nuclear test in Australia, occurs in Maralinga, South Australia.

1957 – October 10 – The Windscale fire occurs in Seascale, Cumbria after a graphite-moderated reactor built for the British hydrogen bomb project catches fire, resulting in the release of radioactive contamination across the United Kingdom and Europe. An inquiry determines that the accident was avoidable and that the British Army ignored warnings by scientists, but is suppressed by the government to prevent damaging the Special Relationship.

1957 – October 15 – The Soviet Union agrees to provide a "sample bomb" and extensive technical assistance to the Chinese nuclear program.
• **1957** – December 12 – The SM-65 Atlas, the first U.S. ICBM, is launched.

• **1957** – December 17 – The Strategic Rocket Forces is established to maintain the Soviet nuclear arsenal.

• **1957** – Iran commences its nuclear program under Shah Mohammad Reza Pahlavi.

• **1957** – The SM-65 Atlas, the first U.S. ICBM, is launched.

• **1958** – The United States and the United Kingdom sign the 1958 US-UK Mutual Defence Agreement. This is a bilateral treaty on nuclear weapons cooperation signed after the United Kingdom successfully tested a hydrogen bomb during Operation Grapple. Under the agreement the United States supplies the United Kingdom with nuclear weapons through Project E.

• **1958** – The U.S. Air Force drafts Project A119, a classified plan to detonate a nuclear bomb on the Moon. The plan is quickly cancelled in favor of a Moon landing.

• **1958** – RAFAEL is formed by the Israeli Ministry of Defense to coordinate its nuclear program.

• **1958** – The Campaign for Nuclear Disarmament is formed in the United Kingdom.

• **1958** – The Jiuquan Atomic Energy Complex is opened in China in the Gansu Province.

• **1958** – The United States considers a nuclear strike on China during the Second Taiwan Strait Crisis, in which China resumed its bombardment of Kinmen and the Matsu Islands.

• **1958** – January – The United States deploys nuclear weapons to South Korea.

• **1958** – August – The PGM-17 Thor intermediate-range ballistic missile, the U.S. Air Force's first ballistic missile, is declared operational and begins deployment in the United Kingdom through Project Emily.

• **1958** – November – The United States and the Soviet Union observe a nuclear-testing moratorium.

• **1958** – November 4 – The Democratic Party wins the 1958 United States elections in part due to public perception of a "missile gap" against the Soviet Union following the release of the *Gaither Report*. Although later proven to be an overestimate, the concept later helps John F. Kennedy to win the 1960 presidential election.

• **1958** – November 10 – Soviet General Secretary Nikita Khrushchev makes a speech demanding the withdrawal of American, British, and French forces from West Berlin, beginning a series of political crises.

• **1959** – Nuclear tests in Antarctica are banned under the Antarctic Treaty.

• **1959** – Fidel Castro takes power in Cuba and creates a Marxism–Leninist government aligned with the Soviet Union.

• **1959** – The Soviet Union scales back nuclear assistance to China as a result of the emerging Sino-Soviet split.
1960 – The United Kingdom cancels the De Havilland Blue Streak medium-range ballistic missile in favor of the American-produced Douglas GAM-87 Skybolt air-launched ballistic missile, ending its attempts to produce an independent delivery system.

1960 – RAND Corporation analyst Herman Kahn releases *On Thermonuclear War*, which argues that the destructiveness of nuclear war can be limited through anti-aircraft defenses, civil defense preparations, and a doctrine targeting counterforces. The book becomes influential in U.S. nuclear strategy and helps formulate the Kennedy administration’s policy of flexible response.

1960 – Operation Chrome Dome, in which nuclear-armed B-52 bombers are continually flown by the U.S. Air Force close to the Soviet Union on continuous alert, begins.

1960 – February 13 – France successfully tests a nuclear weapon, called *Gerboise Bleue*, in the Sahara near Reggane, French Algeria.

1960 – 1 May – An American Lockheed U-2 spy plane piloted by Francis Gary Powers is shot down over Soviet territory, deteriorating Soviet Union–United States relations, sabotaging the Four-Power summit in Paris, and hindering General Secretary Khrushchev’s policy of peaceful coexistence.


1961 – The Israeli Prime Minister David Ben-Gurion informed the Canadian Prime Minister John Diefenbaker that a pilot plutonium-separation plant would be built at the Dimona reactor. Intelligence would indicate from this and other information that Israel intended to produce nuclear weapons.

1961 – Australia considers purchasing nuclear weapons from the United Kingdom, but the idea is rejected by the Cabinet of Prime Minister Robert Menzies.

1961 - President Kennedy announces that the federal government will begin the construction of fallout shelters.

1961 – October 27 – The Berlin crisis occurring after the construction of the Berlin Wall by East German authorities culminates when the United States deploys tanks to Checkpoint Charlie, a move reciprocated by the Soviet Union. President Kennedy and General Secretary Khrushchev ultimately negotiate the removal of the tanks through diplomatic backchannels and prevent a war.

1961 – October 30 – The Soviet Union detonates Tsar Bomba, the largest, most powerful nuclear weapon ever detonated.

1962 – The term "mutually-assured destruction" is coined.

1962 – The Lockheed UGM-27 Polaris, the U.S. Navy's first submarine-launched ballistic missile, is introduced.
• **1962** – The Boeing LGM-30 Minuteman-I, the first American ICBM using liquid-propellant rocket to be able to have an immediate launch, is introduced.

• **1962** – July 9 – The Starfish Prime high-altitude nuclear test over Johnston Island creates an electromagnetic pulse that causes electrical damage in parts of Hawaii, disrupts telecommunications in the Pacific Ocean, and disables satellites in low Earth orbit.

• **1962** – October 17 through October 28 – The Soviet Union attempts to deploy R-12 Dvina medium-range ballistic missiles and R-14 Chusovaya intermediate-range ballistic missiles to Cuba within 90 miles of the contiguous United States, and is discovered by an American U-2 plane. The subsequent Cuban Missile Crisis nearly leads to a world war, and is only averted by an agreement between Soviet General Secretary Nikita Khrushchev and U.S. President John F. Kennedy to withdraw the missiles from Cuba in exchange for a public promise not to invade Cuba and a secret withdrawal of American missiles from Turkey.

• **1962** – December 21 – President John F. Kennedy and Prime Minister Harold Wilson ratify the Nassau Agreement agreeing for the United States to supply the United Kingdom with Polaris submarine-launched missiles. The Polaris Sales Agreement is signed on 6 April 1963 by Secretary of State Dean Rusk and British Ambassador to the United States David Ormsby-Gore.


• **1963** – August – President Kennedy considers using conventional and nuclear air strikes against China’s nuclear facilities to prevent it from developing an atomic bomb.

• **1963** – American nuclear weapons are deployed in Canada, as well as Canadian Armed Forces bases in West Germany, through the NATO nuclear sharing program and NORAD.

• **1964** – January 29 – The Stanley Kubrick film *Dr. Strangelove or, How I Learned to Stop Worrying and Love the Bomb* is released satirizing predominant nuclear strategy.

• **1964** – October 13 – Leonid Brezhnev becomes General Secretary of the Soviet Union, and increases military expenditures.

• **1964** – October 16 – China successfully tests an atomic bomb at Lop Nur.

• **1964** – India produces weapons-grade plutonium.

• **1964** – The R-17 Elbrus tactical ballistic missile enters service in the Soviet Union. The subsequent series of Scud missiles eventually becomes a major proliferation concern.

• **1965** – January – The Soviet Union detonates Chagan as part of their Nuclear Explosions for the National Economy series to study the peaceful use of nuclear explosions.

• **1965** – Pakistan constructs a research reactor purchased from the United States.
• **1965** – The television docudrama *The War Game* is filmed in the United Kingdom as an episode of *The Wednesday Play* anthology series providing a realistic depiction of a nuclear war. Although the film's broadcast is blocked by the BBC and the British government for 20 years due to its disturbing content, it is released abroad to critical acclaim, and receives the 1966 Academy Award for Best Documentary Feature in the United States.

• **1965** – March 10 – Israeli Prime Minister Levi Eshkol claims that Israel "will not be the first state to introduce nuclear weapons" into the Middle East.

• **1965** – The Command Center for the Office of Emergency Planning mistakes the Northeast blackout for a nuclear attack.

• **1966** – France withdraws from SHAPE and the NATO integrated command structure due to disputes over its nuclear weapons and does not rejoin until 2009.

• **1966** – The United States' nuclear stockpile peaks at 31,149 warheads.

• **1966** – China begins moving its nuclear facilities into the interior during its Third Five-Year Plan.

• **1966** – October 27 - China tests a nuclear-armed Dongfeng-2 missile, which launches from Shuangchengzi Space and Missile Center and strikes Lop Nur. It is the only time a country has tested an armed nuclear missile over populated areas.

• **1967** – January – President Johnson claims that the Soviet Union has constructed an anti-ballistic missile barrier around Moscow.

• **1967** – January – The Outer Space Treaty prohibits nuclear tests in space.

• **1967** – February 27 – The Treaty of Tlatelolco is signed in Mexico City, creating a nuclear-weapon-free zone in Latin America.

• **1967** – March 29 – The French Navy launches the *Redoutable*-class submarine.

• **1967** – June 10 – Israel wins the Six-Day War, hindering the nuclear program in Egypt started by Gamal Abdel Nasser.

• **1967** – June 17 – China successfully tests a hydrogen bomb.

• **1967** – June 23–26 – President Johnson and Soviet Premier Alexei Kosygin express a willingness to conduct arms-control negotiations at the Glassboro Summit Conference.

• **1967** – September – The United Kingdom assists France in thermonuclear weapons development in a failed attempt to lobby France to allow Britain to join the European Economic Community.

• **1967** – December – Japan, under Prime Minister Eisaku Satō, adopts the Three Non-Nuclear Principles.

• **1967** – The United States provides Iran with a 5-megawatt research reactor at the University of Tehran and supplies of enriched uranium.

• **1968** – January 28 – An aircraft accident occurs when an American B-52 bomber armed with a Mark 28 nuclear bomb bound for Thule Air Base, Greenland, has an in-flight fire and is forced to make a crash
landing in North Star Bay, resulting in the detonation of the bomb's conventional explosives and the release of radioactive contamination over Greenland. The accident causes the cancellation of Operation Chrome Dome.

- **1968** – February 10 – During the Vietnam War, General William C. Westmoreland orders the movement of nuclear weapons to South Vietnam during the Battle of Khe Sanh, but is overruled by Walt W. Rostow and President Lyndon B. Johnson.

- **1968** – July – The Nuclear Non-Proliferation Treaty opens for signatures. This treaty is intended to limit the spread of nuclear weapons. To date, 189 countries have signed the treaty, including the five permanent members of the UN Security Council. Only India, Israel, Pakistan, and North Korea have not signed the treaty (as sovereign states).

- **1968** – With its ratification of the Nuclear Non-Proliferation Treaty, Sweden formally ends the nuclear weapons program it has run since 1945.

- **1968** - During the 1968 United States presidential election Curtis LeMay becomes the running mate of the controversial American Independent Party candidate George Wallace, and advocates the use of nuclear weapons against North Vietnam. The ticket captures 13.5% of the popular vote and wins five states in the Electoral College.

- **1969** – The United Kingdom transfers its strategic nuclear warheads to its Polaris submarines away from the aging V-bomber fleet.

- **1969** – October – President Richard Nixon, as part of his "madman theory" postulating that the Soviet Union would avoid aggressive acts if they feared an unpredictable response from the United States, and National Security Advisor Henry Kissinger approve Operation Giant Lance, an operation involving nuclear-armed B-52 bombers flying near the Soviet border to simulate an American nuclear attack.

- **1969** – November – The Strategic Arms Limitation Talks commence in Helsinki, Finland.

**1970–1980**

- **1970** – The LGM-30 Minuteman III, the United States's current intercontinental-ballistic missile, is introduced.

- **1970** – The Soviet Navy considers constructing a base for nuclear submarines in Cienfuegos, Cuba.

- **1971** – March 31 – The United States deploys the UGM-73 Poseidon submarine-launched ballistic missile on *James Madison*-class submarines.

- **1971** – December – India wins the Indo-Pakistani War of 1971, resulting in the independence of Bangladesh.

- **1972** – Zulfikar Ali Bhutto launched Pakistan's atomic program in response to the loss of the war by making Munir Ahmad Khan as the program head.
• 1972 – March 26 – The SALT I Agreement is ratified between the United States and the Soviet Union, leading to the Anti-Ballistic Missile Treaty.

• 1972 – April 25 – President Nixon proposes using nuclear weapons to end the Vietnam War, but is quickly dissuaded by National Security Advisor Kissinger.

• 1972 – May – Pakistani nuclear scientist Abdul Qadeer Khan is employed at a Urenco Group nuclear laboratory in Amsterdam and makes repeated visits to an enrichment plant in Almelo.

• 1973 – October – Israel considers using nuclear weapons during the Yom Kippur War, while the Soviet Union considers transporting nuclear weapons to Egypt and causes the United States to place its military on high alert.

• 1974 – South Africa secretly decides to pursue a capability for nuclear bombs, ostensibly for peaceful nuclear explosions.

• 1974 – The Iranian nuclear program is commenced by Shah Mohammad Reza Pahlavi, who founds the Atomic Energy Organization of Iran.

• 1974 – May – India tests its first nuclear device, "Smiling Buddha", at Pokhran using a core designed by Rajagopala Chidambaram.

• 1974 – May – Pakistan's Project-706 is established under command of General Zahid Ali Akbar.

• 1974 – November – A major breakthrough in the SALT II negotiations occurs at the Vladivostok Summit Meeting on Arms Control between General Secretary Leonid Brezhnev and President Gerald Ford.

• 1975 – The number of American nuclear warheads deployed in the Atlantic Ocean peaks at 4,500.

• 1975 - China deploys its first intercontinental ballistic missile, the Dong-Feng 4.

• 1975 - Brazil purchases a nuclear reactor from West Germany, a move criticized by the United States and Mexico due to concerns that it will use the reactor to produce nuclear weapons.

• 1975 – December – Khan returns to Pakistan with photographs and blueprints from his job.

• 1976 – Khan forms the Engineering Research Laboratories with the Pakistan Atomic Energy Commission.

• 1977 – The U.S. Department of Energy is formed to maintain American nuclear weapons. James R. Schlesinger is the first Secretary of Energy.

• 1977 – Walter Pincus reports in The Washington Post that the United States is developing a neutron bomb, a warhead that causes relatively little blast damage but high casualties due to radiation, for deployment in Western Europe. The report causes political controversy in the United States, and U.S. President Jimmy Carter cancels the program in the next year.

• 1977 – March – The Boeing E-3 Sentry is introduced as NATO's primary AWACS aircraft.

• 1977 – July 13 – Somalia invades Ethiopia in the Ogaden War, and congressional support for SALT II in the United States weakens as a result of Soviet intervention in the war.
1978 – France begins development of the Aérospatiale Air-Sol Moyenne Portée missile.

1978 – South Africa develops highly enriched uranium at the Valindaba site near Pretoria.

1978 – Pakistan produces enriched uranium.

1979 – The Warsaw Pact conducts its Seven Days to the River Rhine military simulation emulating a retaliatory nuclear strike against NATO.

1979 – The United States begins to deploy Trident I C-4 missiles, its first SLBMs with intercontinental range, aboard its Ohio-class submarines.

1979 – Iran temporarily halts its nuclear program after the Islamic Revolution.

1979 – June 18 – General Secretary Brezhnev and President Carter sign the SALT II Agreement in Vienna agreeing to limit strategic nuclear weapons.

1979 – September 22 – An American Vela Hotel satellite records a strange double-flash of light near the Prince Edward Islands in Antarctica known as the Vela Incident. The flash is widely believed to have been caused by a nuclear test, possibly carried out by South Africa or Israel.

1979 – November 9 – A computer glitch at NORAD creates a false alarm for a Soviet missile launch, and U.S. nuclear forces prepare for a retaliatory strike.

1979 – December 12 – NATO makes its Double-Track Decision responding to the Soviet Union's increased deployment of RSD-10 Pioneer intermediate-range ballistic missiles and Tupolev Tu-22M bombers by deploying increased numbers of medium-range and intermediate-range ballistic missiles, including Martin Marietta Pershing II missiles and GD BGM-109G Gryphon Ground Launched Cruise Missiles, in Western Europe while continuing to make the Warsaw Pact offers for negotiations. This results in increased east–west international tensions and domestic political controversy.

1979 – December 25 – The Soviet invasion of Afghanistan begins, resulting in collapse of support for SALT II.

1980–1990

1980 – January 3 – President Carter withdraws SALT II from the Senate for formal ratification.

1981 – June 7 – The Israeli Air Force conducts an airstrike, Operation Opera, on Baathist Iraq's light-water nuclear reactor near Baghdad, hindering the country's uranium enrichment and nuclear weapons program. As a result, only a few grams of weapons-grade uranium is produced by the time the program is ended after the Gulf War.

1981 – The United Kingdom's nuclear stockpile peaks at over 500 warheads.
• 1981 – October – President Ronald Reagan announces an update of the U.S. nuclear arsenal, including increased numbers of bombers and missiles and development of new projects such as the Rockwell B-1 Lancer, the MX missile, and the MGM-134 Midgetman missile.

• 1982 – June 12 – The largest anti-war demonstration in history occurs against nuclear weapons in Central Park in New York City during a UN disarmament conference.

• 1982 – The BDS AGM-86 ALCM air-launched cruise missile is introduced in the United States.

• 1983 – The TTAPS study in Science first introduces the possibility of a nuclear winter, and a co-author Carl Sagan publishes an article on the subject in Parade magazine.

• 1983 – March 20 – President Reagan announces the Strategic Defense Initiative to defend against a Soviet nuclear attack.

• 1983 – September 26 – A false alarm occurs in the Soviet Union when the Oko early-warning system malfunctions and erroneously reports an incoming American missile strike. The Soviet Air Defense Forces command officer at the Serpukhov-15 bunker, Lieutenant Colonel Stanislav Petrov, correctly deduces that the alarm was false and does not report it to his superiors, preventing a retaliatory strike.

• 1983 – November 1-11 November – The Soviet Union, which had been monitoring American nuclear forces through the KGB's Operation RYAN, mistakes NATO's Able Archer 83 command post exercise for genuine preparations for a preemptive nuclear strike, and places its forces in East Germany and Poland on high alert.

• 1983 – November 20 – The television film The Day After premieres on ABC, significantly changing attitudes on nuclear war. A similar film, Threads, is released by the BBC and the Nine Network next year, while Testament is released by PBS and Paramount Pictures.

• 1984 – December 23 – The United States begins its deployment of Pershing II missiles to West Germany.

• 1984 – Canada ends its use of American nuclear weapons.

• 1984 – China joins the IAEA, and under Premier Zhao Ziyang expresses a stronger commitment against nuclear proliferation.

• 1984 – Iranian Supreme Leader Ayatollah Ruhollah Khomeini revives Iran's nuclear program due to the stalemate in the Iran-Iraq War and Iran's chronic energy shortages.

• 1985 – International Physicians for the Prevention of Nuclear War is awarded the Nobel Peace Prize.

• 1985 – South Africa decides to covertly build nuclear weapons.

• 1985 – July 10 – The Greenpeace ship Rainbow Warrior is sunken by the DGSE at the Ports of Auckland in New Zealand while traveling to protest French nuclear tests in Moruroa, causing international political controversy.

• 1985 – August 6 – The Treaty of Rarotonga establishes a nuclear-weapons-free zone in the South Pacific.

• 1986 – The Soviet Union's nuclear arsenal peaks at 39,197 warheads.
- **1986** – The Yongbyon Nuclear Scientific Research Center becomes operational near Pyongyang.
- **1986** – New Zealand announces a nuclear-free zone in its territorial waters, resulting in the unofficial cessation of the ANZUS Treaty.
- **1986** – September – Mordechai Vanunu divulges secrets about the Israeli nuclear weapons program to *The Sunday Times* in London. Vanunu would be abducted by the Mossad in Rome and imprisoned.
- **1986** – October 11 – The Reykjavik Summit occurs between President Ronald Reagan and General Secretary Mikhail Gorbachev.
- **1986** – September – Mordechai Vanunu divulges secrets about the Israeli nuclear weapons program to *The Sunday Times* in London. Vanunu would be abducted by the Mossad in Rome and imprisoned.
- **1986** – October 11 – The Reykjavik Summit occurs between President Ronald Reagan and General Secretary Mikhail Gorbachev.
- **1987** – The Missile Technology Control Regime is formed by the Group of Seven to limit proliferation of weapons of mass destruction.
- **1987** – Yugoslavia abandons its nuclear weapons program.
- **1987** – Chang Hsien-yi, a colonel of the Republic of China Army and the deputy director of the INER, defects to the United States and provides the CIA with classified documents revealing a secret nuclear weapons program in Taiwan. The program is shut down by ROC President Chiang Ching-kuo under pressure from the IAEA and President Reagan.
- **1987** – The United States ends production of nuclear material for weapons.
- **1987** – December 8- The Intermediate-Range Nuclear Forces Treaty is signed by Gorbachev and Reagan at the Washington Summit, and is later ratified by both countries.
- **1988** – Switzerland abandons its nuclear weapons program.
- **1988** – Pakistan reportedly has the capacity to build a nuclear bomb.
- **1989** – South Africa opts to dismantle the six nuclear weapons it has secretly built amid the negotiations to end apartheid.

**1990–2000**

- **1990** – July – NATO issues the London Declaration declaring its relations with the Warsaw Pact and the Soviet Union to be no longer adversarial and urging reductions in tactical nuclear forces in Europe.
- **1990** – October 16 – The Radiation Exposure Compensation Act is ratified in the United States, providing monetary compensation to victims of radiation-related illnesses, including cancer, caused by contact with nuclear testing and uranium mining.
1991 – South Africa signs the Nuclear Non-Proliferation Treaty; they also announce that from 1979 to 1989, they had built and then dismantled a number of nuclear weapons. The IAEA confirms that the program has been fully dismantled.

1991 – France and China ratify the Nuclear Non-Proliferation Treaty.

1991 – June – The Brazilian-Argentine Agency for Accounting and Control of Nuclear Materials is established to play an active role in verifying the pacific use of nuclear materials that could be used for the manufacture of nuclear weapons in Argentina and Brazil.


1991 – Soviet President Mikhail Gorbachev signs a moratorium on nuclear weapons testing. The Soviet Union's 1990 nuclear test series became its last.

1991 – December – The United States withdraws its nuclear weapons from South Korea.

1991 – December 25 – The Soviet Union, which possesses the largest nuclear arsenal in the world, collapses. Gorbachev hands over the nuclear briefcase, the Cheget, to the new Russian President Boris Yeltsin.

1991 – December 30 – The Commonwealth of Independent States ratifies a preliminary agreement to transfer nuclear weapons of the former Soviet Union held in Belarus, Ukraine, and Kazakhstan to the new Russian Federation, but to allow their governments to veto their use.

1992 – The U.S. Senate votes for a nuclear testing moratorium despite opposition from President George HW Bush and Defense Secretary Dick Cheney. Operation Julin is the final American weapons test, and also ends British nuclear testing in the United States.

1992 – France's nuclear stockpile peaks at over 500 warheads.

1993 – January 3 – The United States and Russia mutually agree to ban multiple independently targetable reentry vehicles through the START II Treaty.

1993 – Russia formulates a military doctrine de-emphasizing nuclear weapons except in the case of a large-scale global conflict, although President Yeltsin authorizes development of the RT-2PM2 Topol-M intercontinental ballistic missile and the Borei-class submarine fleet.

1993 – The United States agrees to purchase excess highly enriched uranium from dismantled Soviet nuclear warheads from Russia for conversion into lower-grade uranium for electricity production through the Megatons to Megawatts Program.

1993 – North Korea rejects IAEA inspections and threatens to withdraw from the Nuclear Non-Proliferation Treaty.

1994 – January – The United States and Russia negotiate a detargeting agreement that they will no longer directly target each other with nuclear weapons.
• 1994 – After a meeting between Kim Il-Sung and Jimmy Carter and the ratification of the Agreed Framework, North Korea agrees to freeze its nuclear program in exchange for aid, easing of sanctions, and two civilian light-water reactors, which are built by the Korean Peninsula Energy Development Corporation.

• 1994 – The Vanguard-class submarines are introduced by the Royal Navy as an upgrade of the British strategic nuclear force, and carry American-built UGM-133 Trident II missiles.

• 1994 – December 10 – Ukraine agrees to the Budapest Memorandum transferring its strategic nuclear weapons to Russia and dismantling its nuclear infrastructure through the U.S.-sponsored Cooperative Threat Reduction Program in exchange for a guarantee of sovereignty from Russia.

• 1995 – The Comprehensive Nuclear-Test-Ban Treaty is ratified by 168 states. India, Pakistan, and North Korea have not signed the Treaty while China, Iran, Israel, and the United States have signed but not ratified it.

• 1995 – Russia agrees to complete the Bushehr Nuclear Power Plant in Iran that had been commenced by West Germany in the 1970s.

• 1995 – January 27 – A false alarm occurs after a Norwegian Black Brant XII sounding rocket launched to study the aurora borealis from Andøya is mistaken for an American high-altitude nuclear attack by Russia's Main Centre for Missile Attack Warning, and President Yeltsin activates the Cheget before the error is rectified.

• 1995 – April – Kazakhstan completes the transfer of its nuclear weapons to Russia.

• 1996 – January – France performs its last nuclear tests to date on Moruroa atoll.

• 1996 – April 11 – The Treaty of Pelindaba is ratified, creating a nuclear-weapon-free zone in Africa.

• 1996 – July 8 – The International Court of Justice rules in its Advisory opinion on the Legality of the Threat or Use of Nuclear Weapons that the use and threat of nuclear weapons is legal under international law.

• 1996 – July 29 – China conducts its final nuclear test.

• 1996 – Belarus and Ukraine complete the transfer of strategic nuclear weapons, ICBMs, and strategic bombers they had inherited after the dissolution of the Soviet Union to Russia through the U.S.-sponsored Cooperative Threat Reduction Program.

• 1997 – France launches Operation Xouthos, its final nuclear test.

• 1997 – March 21 – France launches the first of its Triomphant-class submarines.

• 1997 – After the U.S. Senate ratifies the START II Agreement, President Clinton and President Yeltsin begin negotiations for START III. The talks collapse due to tensions over NATO intervention in the Kosovo War, the 1998 U.S. bombing of Iraq, and Operation Infinite Reach.
• 1998 – The United Kingdom decommissions the WE.177 bomb, the final warhead used by the Royal Air Force and the final tactical nuclear weapon used by Britain. The United Kingdom shifts towards exclusive reliance on its strategic SLBM programs for a nuclear deterrent in its Strategic Defence Review.

• 1998 – May – India tests five more nuclear weapons as part of Operation Shakti at the Pokhran test site. This was India's second round of nuclear weapons testing.

• 1998 – May – Pakistan detonates five high-enriched uranium nuclear weapons in the Chagai Hills. A sixth nuclear test, at Kharan, was a plutonium device.

• 1998 – The Iraqi disarmament crisis intensifies after Saddam Hussein forces the UN inspectors out, leading to Operation Desert Fox.

• 1999 – The U.S. Defense Intelligence Agency estimates that Israel possesses between 60 and 80 nuclear weapons.

2000–2010

• 2000 – January – Russia publicly begins to reformulate its doctrine to include the possibility of a nuclear response to a large-scale conventional attack.

• 2002 – U.S. President George W. Bush refuses to certify North Korea's compliance with the Agreed Framework and links it in an "Axis of Evil" with Iraq and Iran.

• 2002 – The National Council of Resistance of Iran reports the existence of secret Iranian nuclear facilities at Natanz and Arak. The IAEA inspects them a year later.

• 2002 – The Strategic Offensive Reductions Treaty is signed by U.S. President Bush and Russian President Vladimir Putin, and is ratified by the U.S. Senate and the Russian State Duma on June 1.

• 2002 – June – The United States withdraws from the ABM Treaty, while Russia withdraws from the START II Agreement.


• 2002 – November 13 – UNMOVIC inspectors return to Iraq after the Iraq Resolution and UN Security Council Resolution 1441 to ensure that it has ended its CNBR weapons.

• 2002 – November 25 – The International Code of Conduct against Ballistic Missile Proliferation is ratified at The Hague, Netherlands, regulating proliferation of nuclear-capable ballistic missiles.

• 2002 – December 16 – President Bush issues a national security directive to construct a missile defense system in California and Alaska.
• **2003** – March 20 – Although Hans Blix and Mohamed ElBaradei claim there is no evidence that Iraqi CNBR weapons development has resumed, President Bush authorizes the U.S.-lead invasion of Iraq. During the occupation of Iraq no evidence of weapons of mass destruction is found.

• **2003** – North Korea withdraws from the Nuclear Non-Proliferation Treaty.

• **2003** – North Korea announces that it has several nuclear explosives. The Six-Party Talks begin in Beijing.

• **2003** – December – Libya announces the closure of its WMD programs, including an early attempt to develop an atomic bomb using designs from Abdul Qadeer Khan.

• **2005** - June - Mahmoud Ahmadinejad is elected President of Iran and declares that Iran has a right to construct nuclear weapons.

• **2005** – August – In Iran, Ayatollah Ali Khamenei issued a fatwa forbidding the production, stockpiling and use of nuclear weapons.

• **2006** – May – The United States begins preparing missile defense systems in the Czech Republic and Poland.

• **2006** - April 11 - President Ahmedinejad announces that Iran has produced enriched uranium in defiance of the UN and the IAEA, leading to sanctions.

• **2006** – July – Prior to the 32nd G8 summit, Russia threatens to retaliate to missile defense preparations in Eastern Europe by targeting European urban centers.

• **2006** – October 9 – North Korea tests a nuclear weapon for the first time in the Hamgyong Mountains.

• **2006** – December – The Blair government in the United Kingdom issues a white paper announcing development of a new nuclear submarine using the Rolls-Royce PWR3 nuclear reactor.

• **2008** – The Russian Navy conducts ten limited patrols with its strategic nuclear submarines, its greatest amount since the collapse of the Soviet Union.

• **2008** – January – Israel is believed to have tested its first intercontinental ballistic missile, the Jericho III.

• **2008** – November – Poland and the Czech Republic agree to delay deployment of radar sites until after the 2008 United States presidential elections and the presidential transition.

• **2009** – April 4 – President Barack Obama pledges a "world without nuclear weapons" in a speech at Hradčany Square in Prague, Czech Republic.

• **2009** – November 12 – President Obama announces changes to the NATO missile defense system, including an increased reliance on the sea-based Aegis Ballistic Missile Defense System and the AN/TPY-2 radar, and the RIM-161 Standard Missile 3 missile system.

• **2009** - October 29 - Iran rejects the Obama administration's first proposal for an anti-nuclear agreement.
2010–present

- **2010** – North Korea reveals its new uranium-enrichment plant during tensions from the ROKS *Cheonan* sinking, the May 24 measures, and the bombardment of Yeonpyeong.

- **2010** – February – Russia issues a revision of its military doctrine limiting the use of nuclear weapons to strictly defensive purposes.

- **2010** – April 8 – U.S. President Barack Obama and Russian President Dimitri Medvedev sign the New START Treaty reducing strategic warheads.

- **2010** – May – The United Kingdom releases the Strategic Defence and Security Review under the Cameron-Clegg coalition pledging to limit to limit its number of operational nuclear warheads to 120 with 40 per submarine, which it does by January 2015.

- **2010** – November 2 – The United Kingdom and France agree to closer cooperation regarding nuclear forces in the Lancaster House Treaties.

- **2012** – Russia announces that it will resume regular patrols with its SSBN fleet in international waters.

- **2012** – April 19 – India tests its first intercontinental ballistic missile, the Agni-V.

- **2012** – October – The Ministry of Foreign Affairs states that Russia will not renew the framework for cooperation with the United States on nuclear dismantlement after the expiration of the Nunn-Lugar Act.

- **2013** – After negotiations between Iran and the P5+1, the Joint Plan of Action is adopted.

- **2013** – June – President Obama proposes reducing American strategic nuclear weapons to their lowest point since 1953 in a speech at the Brandenburg Gate in Berlin.

- **2013** – The U.S. Department of Defense reports to Congress that the PLA Navy is developing an ballistic missile submarine force.

- **2014** – September 18 – The 2014 Scottish independence referendum occurs and support for the Scottish National Party begins to grow. Speculations begin on how to withdraw the British nuclear arsenal from Scotland, where its SSBN fleet is deployed at HMNB Clyde and its nuclear arsenal is stored at RNAD Coulport, if it received independence or full fiscal autonomy.

- **2014** – December – After increasing tensions in Russia–United States diplomatic relations following the Russian annexation of Crimea and the Russian military intervention in Ukraine, cooperation with the United States on securing Russian nuclear stockpiles ends.

- **2015** – Under the Joint Comprehensive Plan of Action, Iran agrees to limit its uranium-enrichment operations in exchange for submitting to IAEA inspections and reduced sanctions.

- **2015** – Reports about Russia's Status-6 Oceanic Multipurpose System, a system of unmanned underwater vehicles capable of delivering a thermonuclear cobalt bomb, leak.
• **2015** – September 12 – Jeremy Corbyn, a longtime opponent of nuclear weapons, wins the 2015 Labour Party leadership election and becomes Leader of the Opposition. He proposes ending the Trident programme or removing the Trident missiles' nuclear capability.

• **2015** – November – The Strategic Defence and Security Review 2015 announces the *Dreadnought*-class submarines a replacement for Britain's aging *Vanguard*-class submarines and Trident missiles, but is eventually delayed due to "Brexit".

• **2016** – January – North Korea Hydrogen bomb is 'tested' and confirmed by North Korea leader Kim Jong-Un.

• **2016** – May 27 – President Obama becomes the first American head of state to visit Hiroshima, expressing sympathy for victims but not issuing a public apology for the bombings as many expected.

• **2017** – July 7- The Treaty on the Prohibition of Nuclear Weapons, the first legally-binding international nuclear weapons ban, is ratified by 90 countries. The International Campaign to Abolish Nuclear Weapons wins the Nobel Peace Prize for its campaigning for the Treaty.

• **2017** – September – North Korea conducted its seventh nuclear test with a yield between fifty and two hundred fifty kilotons, causing an international crisis. President Donald Trump adopts more bellicose rhetoric towards the country.

• **2017** – December 12 – The National Defense Authorization Act for Fiscal Year 2018 is ratified, declaring Russia to be in violation of the INF Treaty.

• **2018** – February – Under President Trump, the U.S. Department of Defense's Nuclear Posture Review announces the first expansion of the United States' nuclear arsenal since the end of the Cold War, citing violations of non-proliferation treaties by China and Russia as well as the Russian military intervention in Ukraine and the South China Sea territorial disputes.

• **2018** – March 15 – Crown Prince Mohammad bin Salman announces on a *60 Minutes* interview that the Kingdom of Saudi Arabia will pursue nuclear weapons in the event of a successful Iranian nuclear test.

• **2018** – April 27 – Kim Jong-un meets South Korean President Moon Jae-in in Panmunjom for a summit and pledges a denuclearized Korean Peninsula.

• **2018** – May 1 – President Putin announces a major modernization to Russian nuclear forces in his annual Presidential Address to the Federal Assembly, including announcing the Avangard hypersonic glide vehicle.

• **2018** – May 8 – President Trump announces the United States withdrawal from the Joint Comprehensive Plan of Action.

• **2018** – June 12 – Trump and Kim meet at the 2018 North Korea–United States Singapore Summit, the first American and North Korean heads of state to meet, and issue a joint declaration pledging a denuclearized Korea.

• **2019** – February – The United States and Russia withdraw from the INF Treaty.
2019 – February 28 – The 2019 North Korea–United States Hanoi Summit ends prematurely without a deal, but both parties express commitment to a better relationship.

Timeline of photography technology

Prior to the 20th century

- c. 1717 – Johann Heinrich Schulze makes fleeting sun prints of words by using stencils, sunlight, and a bottled mixture of chalk and silver nitrate in nitric acid, simply as an interesting way to demonstrate that the substance inside the bottle darkens where it is exposed to light.
- c. 1800 – Thomas Wedgwood conceives of making permanent pictures of camera images by using a durable surface coated with a light-sensitive chemical. He succeeds only in producing silhouettes and other shadow images, and is unable to make them permanent.
- 1816 – Nicéphore Niépce succeeds in making negative photographs of camera images on paper coated with silver chloride, but cannot adequately "fix" them to stop them from darkening all over when exposed to light for viewing.
- 1822 – Niépce abandons silver halide photography as hopelessly impermanent and tries using thin coatings of Bitumen of Judea on metal and glass. He creates the first fixed, permanent photograph, a copy of an engraving of Pope Pius VII, by contact printing in direct sunlight without a camera or lens. It is later destroyed; the earliest surviving example of his "heliographic process" is from 1825.
- 1824 – Niépce makes the first durable, light-fast camera photograph, similar to his surviving 1826–1827 photograph on pewter but created on the surface of a lithographic stone. It is destroyed in the course of subsequent experiments.
- 1826 or 1827 – Niépce makes what is now the earliest surviving photograph from nature, a landscape. It requires an exposure in the camera that lasts at least eight hours and probably several days.
- 1834 – Hércules Florence, a French-Brazilian painter and the isolate inventor of photography in Brazil, coined the word photographie for his technique, at least four years before John Herschel coined the English word photography.
- 1835 – Henry Fox Talbot produces durable silver chloride camera negatives on paper and conceives the two-step negative-positive procedure used in most non-electronic photography up to the present.
- 1839 – Louis Daguerre publicly introduces his daguerreotype process, which produces highly detailed permanent photographs on silver-plated sheets of copper. At first, it requires several minutes of exposure in the camera, but later improvements reduce the exposure time to a few seconds. Photography suddenly enters the public consciousness and Daguerre's process is soon being used worldwide.
- 1839 – Talbot publicly introduces the paper-based process he worked out in 1835, calling it "photogenic drawing", but it requires much longer exposures than the daguerreotype and the results are not as clear and detailed.
- 1839 – Hippolyte Bayard presents the first public exhibition of photographs. He claims to have invented a photographic process prior to Daguerre and Talbot.
- 1839 – Sarah Anne Bright creates a series of photograms, six of which are known to still exist. These are the earliest surviving photographic images created by a woman.
- 1839 – John Herschel introduces hyposulfite of soda (now known as sodium thiosulfate but still nicknamed "hypo") as a highly effective fixer for all silver-based processes. He also makes the first glass negative.
- 1841 – Talbot introduces his patented calotype (or "talbotype") paper negative process, an improved version of his earlier process that greatly reduces the required exposure time.
- 1845 – Francis Ronalds invents the first successful camera for continuous recording of the variations in meteorological and geomagnetic parameters over time
- 1848 – Edmond Becquerel makes the first full-color photographs, but they are only laboratory curiosities: an exposure lasting hours or days is required and the colors are so light-sensitive that they sometimes fade right before the viewer's eyes while being examined.
- 1851 – Introduction of the collodion process by Frederick Scott Archer, used for making glass negatives, ambrotypes and tintypes.
- 1850s – Combination printing was introduced, probably first suggested by Hippolyte Bayard when he thought of using a separate negative of a properly exposed sky in combination with a proper negative of the landscape or monument documented for the Missions Héliographiques that started in 1851.
- 1854 – British Journal of Photography (initially established as the Liverpool Photographic Journal) first issue was published on 14 January 1854
- 1854 – André-Adolphe-Eugène Disdéri credited with introduction of the carte de visite (English: visiting card or calling card) format for portraiture. Disdéri uses a camera with multiple lenses that can photograph eight different poses on one large negative. After printing on albumen paper, the images are cut apart and glued to calling-card-size mounts.
- 1861 – James Clerk Maxwell presents a projected additive color image of a multicolored ribbon, the first demonstration of color photography by the three-color method he suggested in 1855. It uses three separate black-and-white photographs taken and projected through red, green and blue color filters. The projected image is temporary but the set of three "color separations" is the first durable color photograph.
- 1868 – Louis Ducos du Hauron patents his numerous ideas for color photography based on the three-color principle, including procedures for making subtractive color prints on paper. They are published the following year. Their implementation is not technologically practical at that time, but they anticipate most of the color processes that are later introduced.
• 1871 – The gelatin emulsion is invented by Richard Maddox.

• 1873 – Hermann Wilhelm Vogel discovers dye sensitization, allowing the blue-sensitive but otherwise color-blind photographic emulsions then in use to be made sensitive to green, yellow and red light. Technical problems delay the first use of dye sensitization in a commercial product until the mid-1880s; fully panchromatic emulsions are not in common use until the mid-20th century.

• 1876 – Hurter & Driffield begin systematic evaluation of sensitivity characteristics of photographic emulsions — the science of sensitometry.

• 1878 – Heat ripening of gelatin emulsions is discovered. This greatly increases sensitivity and makes possible very short "snapshot" exposures.

• 1878 – Eadweard Muybridge uses a row of cameras with trip-wires to make a high-speed photographic analysis of a galloping horse. Each picture is taken in less than the two-thousandth part of a second, and they are taken in sufficiently rapid sequence (about 25 per second) that they constitute a brief real-time "movie" that can be viewed by using a device such as a zoetrope, a photographic "first".

• 1887 – Celluloid film base introduced.

• 1888 – The Kodak n°1 box camera, the first easy-to-use camera, is introduced with the slogan, "You press the button, we do the rest."

• 1888 – Louis Le Prince makes Roundhay Garden Scene. It is believed to be the first-ever motion picture on film.

• 1889 – The first commercially available transparent celluloid roll film is introduced by the Eastman Company, later renamed the Eastman Kodak Company and commonly known as Kodak.

• 1891 – Gabriel Lippmann announces a "method of reproducing colors photographically based on the phenomenon of interference".

• 1891 – William Kennedy Laurie Dickson develops the "kinetoscopic" motion picture camera while working for Thomas Edison.

• 1895 – Auguste and Louis Lumiére invent the cinématographe.

• 1898 – Kodak introduces the Folding Pocket Kodak.

• 1900 – Kodak introduces their first Brownie, a very inexpensive user-reloadable point-and-shoot box camera.

20th century onwards

• 1901 – Kodak introduces the 120 film format.
• 1902 – Arthur Korn devises practical telephotography technology (reduction of photographic images to signals that can be transmitted by wire to other locations). *Wire-Photos* are in wide use in Europe by 1910, and transmitted to other continents by 1922.

• 1907 – The Autochrome plate is introduced. It becomes the first commercially successful color photography product.

• 1908 – Kinemacolor, a two-color process known as the first commercial "natural color" system for movies, is introduced.

• 1909 – Kodak announces a 35 mm "safety" motion picture film on an acetate base as an alternative to the highly flammable nitrate base. The motion picture industry discontinues its use after 1911 due to technical imperfections.

• 1912 – Vest Pocket Kodak using 127 film.

• 1912 – Thomas Edison introduces a short-lived 22 mm home motion picture format using acetate "safety" film manufactured by Kodak.

• 1913 – Kodak makes 35 mm panchromatic motion picture film available on a bulk special order basis.

• 1914 – Kodak introduces the Autographic film system.

• 1914 – *The World, the Flesh and the Devil*, made in Kinemacolor, is the first dramatic feature film in color released.

• 1922 – Kodak makes 35 mm panchromatic motion picture film available as a regular stock.

• 1923 – The 16 mm amateur motion picture format is introduced by Kodak. Their Cine-Kodak camera uses reversal film and all 16 mm is on an acetate (safety) base.

• 1923 – Harold Edgerton invents the xenon flash lamp for strobe photography.

• 1925 – The Leica introduces the 35 mm format to still photography.

• 1926 – Kodak introduces its 35 mm Motion Picture Duplicating Film for duplicate negatives. Previously, motion picture studios used a second camera alongside the primary camera to create a duplicate negative.

• 1932 – "Flowers and Trees", the first full-color cartoon, is made in Technicolor by Disney.

• 1932 – Kodak introduces the first 8 mm amateur motion picture film, cameras, and projectors.

• 1934 – The 135 film cartridge is introduced, making 35 mm easy to use for still photography.

• 1935 – *Becky Sharp*, the first feature film made in the full-color "three-strip" version of Technicolor, is released.

• 1935 – Introduction of Kodachrome multi-layered color reversal film (16 mm only; 8 mm and 35 mm follow in 1936, sheet film in 1938).

• 1936 – Introduction by IHAGEE of the Ihagee Kine Exakta 1, the first 35 mm SLR (Single Lens Reflex) camera.
• 1936 – Agfacolor Neu (English: New Agfacolor) color reversal film for home movies and slides.
• 1939 – Agfacolor negative and positive 35 mm color film stock for professional motion picture use (not for making paper prints).
• 1939 – The View-Master 3-D viewer and its "reels" of seven small stereoscopic image pairs on Kodachrome film are introduced.
• 1942 – Kodacolor, the first color film that yields negatives for making chromogenic color prints on paper. Roll films for snapshot cameras only, 35 mm not available until 1958.
• 1947 – Dennis Gabor invents holography.
• 1947 – Harold Edgerton develops the Rapatronic camera for the U.S. government.
• 1948 – The Hasselblad camera is introduced.
• 1948 – Edwin H. Land introduces the first Polaroid instant camera.
• 1949 – The Contax S camera is introduced, the first 35 mm SLR camera with a pentaprism eye-level viewfinder.
• 1952 – *Bwana Devil*, a low-budget polarized 3-D film, premieres in late November and starts a brief 3-D craze that begins in earnest in 1953 and fades away during 1954.
• 1954 – Leica M Introduced
• 1957 – First Asahi Pentax SLR introduced.
• 1957 – First digital computer acquisition of scanned photographs, by Russell Kirsch et al. at the U.S. National Bureau of Standards (now the NIST).
• 1959 – Nikon F introduced.
• 1959 – AGFA introduces the first fully automatic camera, the *Optima*.
• 1963 – Kodak introduces the Instamatic.
• 1964 – First Pentax Spotmatic SLR introduced.
• 1967 – First MOS 10 by 10 active pixel array shown by Noble
• 1972 – Integrated Photomatrix (Noble) demonstrates for 64 by 64 MOS active pixel array
• 1973 – Fairchild Semiconductor releases the first large image forming CCD chip: 100 rows and 100 columns of pixels.
• 1974 – Josef H. Neumann created the first Chemograms combining the disciplines painting and photography within the photographic layer for the first time.
• 1975 – Bryce Bayer of Kodak develops the Bayer filter mosaic pattern for CCD color image sensors.
• 1976 – Steadicam becomes available.
• 1986 – Kodak scientists invent the world's first megapixel sensor.
• 1992 – Photo CD created by Kodak.
• 1993–95 – The Jet Propulsion Laboratory develops devices using CMOS or active pixel sensors.
• 1994 – Nikon introduces the first optical-stabilized lens.
• 1995 – "Kodak DC40 and the Apple QuickTake 100 become the first digital cameras marketed for consumers."
• 1996 – Eastman Kodak, FujiFilm, AgfaPhoto, and Konica introduce the Advanced Photo System (APS).
• 1997 – first known publicly shared picture via a cell phone, by Philippe Kahn.
• 2000 – J-SH04 introduced by J-Phone, the first commercially available mobile phone with a camera that can take and share still pictures.
• 2005 – AgfaPhoto files for bankruptcy. The production of Agfa brand consumer films ends.
• 2006 – Dalsa produces a 111 megapixel CCD sensor, the highest resolution at that time.
• 2008 – Polaroid announces it is discontinuing the production of all instant film products, citing the rise of digital imaging technology.
• 2009 – Kodak announces the discontinuance of Kodachrome film.
• 2009 – FujiFilm launches world's first digital 3D camera with 3D printing capabilities.
• 2011 – Lytro releases the first pocket-sized consumer light-field camera, capable of refocusing images after they are taken.
• 2018 – Kodak resumes the production of Ektachrome film.

**Timeline of electrical and electronic engineering**

**History of discoveries timeline**

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2750 BC</td>
<td>Ancient Egyptian texts described electric fish and identified them with thunder</td>
</tr>
<tr>
<td>600 BC</td>
<td>Ancient Greek philosopher Thales of Miletus described static electricity by rubbing fur on substances such as amber</td>
</tr>
<tr>
<td>800 AD</td>
<td>Arabic naturalists and physicians described electric fish and electrostatic phenomena.</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
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<tr>
<td>------</td>
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<tr>
<td>1300</td>
<td>Arabic naturalists and physicians described electric rays and identified them with lightning</td>
</tr>
<tr>
<td>1600</td>
<td>English scientist William Gilbert coined the word <em>electricus</em> after careful experiments.</td>
</tr>
<tr>
<td>1660</td>
<td>Otto von Guericke invented the device that creates static electricity. This is the first ever electric generator.</td>
</tr>
<tr>
<td>1705</td>
<td>English scientist Francis Hauksbee made a glass ball that glowed when spun and rubbed with the hand</td>
</tr>
<tr>
<td>1720</td>
<td>English scientist Stephen Gray made the distinction between insulators and conductors</td>
</tr>
<tr>
<td>1745</td>
<td>German physicist Ewald Georg von Kleist and Dutch scientist Pieter van Musschenbroek invented Leyden jars</td>
</tr>
<tr>
<td>1752</td>
<td>American scientist Benjamin Franklin showed that lightning was electrical by flying a kite, and explained how Leyden jars work</td>
</tr>
<tr>
<td>1780</td>
<td>Italian scientist Luigi Galvani discovered the Galvanic action in living tissue</td>
</tr>
<tr>
<td>1785</td>
<td>French physicist Charles-Augustin de Coulomb formulated and published Coulomb's law in his paper <em>Premier Mémoire sur l'Électricité et le Magnétisme</em></td>
</tr>
<tr>
<td>1785</td>
<td>French mathematician Pierre-Simon Laplace developed the Laplace transform to transform a linear differential equation to an algebraic equation. Later, his transform became a tool in circuit analysis.</td>
</tr>
<tr>
<td>1800</td>
<td>Italian physicist Alessandro Volta invented the battery</td>
</tr>
<tr>
<td>1804</td>
<td>Thomas Young: Wave theory of light, Vision and color theory</td>
</tr>
<tr>
<td>1808</td>
<td>Atomic theory by John Dalton</td>
</tr>
<tr>
<td>1816</td>
<td>English inventor Francis Ronalds built the first working electric telegraph</td>
</tr>
<tr>
<td>1820</td>
<td>Danish physicist Hans Christian Ørsted accidentally discovered that an electric field creates a magnetic field</td>
</tr>
<tr>
<td>1820</td>
<td>One week after Ørsted's discovery, French physicist André-Marie Ampère published his law. He also proposed right-hand screw rule</td>
</tr>
<tr>
<td>1821</td>
<td>German scientist Thomas Johann Seebeck discovered thermoelectricity</td>
</tr>
<tr>
<td>1825</td>
<td>English physicist William Sturgeon developed the first electromagnet</td>
</tr>
<tr>
<td>1827</td>
<td>German physicist Georg Ohm introduced the concept of electrical resistance</td>
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<tr>
<td>Year</td>
<td>Event</td>
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<tr>
<td>1831</td>
<td>English physicist Michael Faraday published the law of induction (Joseph Henry developed the same law independently)</td>
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<tr>
<td>1831</td>
<td>American scientist Joseph Henry in United States developed a prototype DC motor</td>
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<tr>
<td>1832</td>
<td>French instrument maker Hippolyte Pixii in France developed a prototype DC generator</td>
</tr>
<tr>
<td>1833</td>
<td>Michael Faraday developed laws of electrolysis</td>
</tr>
<tr>
<td>1833</td>
<td>Michael Faraday invented thermistor</td>
</tr>
<tr>
<td>1833</td>
<td>English Samuel Hunter Christie invented Wheatstone bridge (It is named after Charles Wheatstone who popularized it)</td>
</tr>
<tr>
<td>1836</td>
<td>Irish priest (and later scientist) Nicholas Callan invented transformer in Ireland</td>
</tr>
<tr>
<td>1837</td>
<td>English scientist Edward Davy invented the electric relay</td>
</tr>
<tr>
<td>1839</td>
<td>French scientist Edmond Becquerel discovered the Photovoltaic Effect</td>
</tr>
<tr>
<td>1844</td>
<td>American inventor Samuel Morse developed telegraphy and the Morse code</td>
</tr>
<tr>
<td>1845</td>
<td>German physicist Gustav Kirchhoff developed two laws now known as Kirchhoff's Circuit laws</td>
</tr>
<tr>
<td>1850</td>
<td>Belgian engineer Floris Nollet invented (and patented) a practical AC generator</td>
</tr>
<tr>
<td>1851</td>
<td>Heinrich Daniel Ruhmkorff first coil, which he patented in 1851</td>
</tr>
<tr>
<td>1855</td>
<td>First utilization of AC (in electrotherapy) by French neurologist Guillaume Duchenne</td>
</tr>
<tr>
<td>1856</td>
<td>Belgian engineer Charles Bourseul proposed telephony</td>
</tr>
<tr>
<td>1856</td>
<td>First electrically powered light house in England</td>
</tr>
<tr>
<td>1860</td>
<td>German scientist Johann Philipp Reis invented Microphone</td>
</tr>
<tr>
<td>1862</td>
<td>Scottish physicist James Clerk Maxwell published four equations bearing his name</td>
</tr>
<tr>
<td>1866</td>
<td>Transatlantic telegraph cable</td>
</tr>
<tr>
<td>1873</td>
<td>Belgian engineer Zenobe Gramme who developed DC generator accidentally discovered that a DC generator also works as a DC motor during an exhibit in Vienna.</td>
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<tr>
<td>Year</td>
<td>Event</td>
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<tr>
<td>1876</td>
<td>Russian engineer Pavel Yablochkov invented electric carbon arc lamp</td>
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<tr>
<td>1876</td>
<td>Scottish inventor Alexander Graham Bell patented the telephone</td>
</tr>
<tr>
<td>1877</td>
<td>American inventor Thomas Alva Edison invented phonograph</td>
</tr>
<tr>
<td>1877</td>
<td>German industrialist Werner von Siemens developed primitive loudspeaker</td>
</tr>
<tr>
<td>1878</td>
<td>First street lighting in Paris, France</td>
</tr>
<tr>
<td>1878</td>
<td>First hydroelectric plant in Cragside, England</td>
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<tr>
<td>1878</td>
<td>William Crookes invents Crooks tube a prototype of Vacuum tubes</td>
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<tr>
<td>1878</td>
<td>English engineer Joseph Swan invented Incandescent light bulb</td>
</tr>
<tr>
<td>1879</td>
<td>American physicist Edwin Herbert Hall discovered Hall Effect</td>
</tr>
<tr>
<td>1879</td>
<td>Thomas Alva Edison introduced a long lasting filament for the incandescent lamp.</td>
</tr>
<tr>
<td>1880</td>
<td>French physicists Pierre Curie and Jacques Curie discovered Piezoelectricity</td>
</tr>
<tr>
<td>1882</td>
<td>First thermal power stations in London and New York</td>
</tr>
<tr>
<td>1883</td>
<td>English physicist J J Thomson invented waveguides</td>
</tr>
<tr>
<td>1887</td>
<td>German American inventor Emile Berliner invented gramophone record</td>
</tr>
<tr>
<td>1888</td>
<td>German physicist Heinrich Hertz proves the existence of electromagnetic waves, including what would come to be called radio waves.</td>
</tr>
<tr>
<td>1888</td>
<td>Italian physicist and electrical engineer Galileo Ferraris publishes a paper on the induction motor and Serbian-American engineer Nikola Tesla gets a US patent on the same device</td>
</tr>
<tr>
<td>1890</td>
<td>Thomas Alva Edison invents the fuse</td>
</tr>
<tr>
<td>1893</td>
<td>During the Fourth International Conference of Electricians in Chicago electrical units were defined</td>
</tr>
<tr>
<td>1894</td>
<td>Indian physicist Jagadish Chandra Bose introduced use of semiconductor junction to detect radio waves</td>
</tr>
<tr>
<td>1894</td>
<td>Indian physicist Jagadish Chandra Bose discovered extremely high frequency millimetre waves</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
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<tr>
<td>1894</td>
<td>Russian physicist Alexander Stepanovich Popov finds a use for radio waves, building a radio receiver that can detect lightning strikes.</td>
</tr>
<tr>
<td>1895</td>
<td>Discovery of X-rays by Wilhelm Röntgen.</td>
</tr>
<tr>
<td>1896</td>
<td>First successful intercontinental telegram.</td>
</tr>
<tr>
<td>1897</td>
<td>German inventor Karl Ferdinand Braun invented cathode ray oscilloscope (CRO).</td>
</tr>
<tr>
<td>1900</td>
<td>Italian inventor Guglielmo Marconi builds first radio communication system, based on radiotelegraphy.</td>
</tr>
<tr>
<td>1901</td>
<td>First transatlantic radio transmission by Guglielmo Marconi.</td>
</tr>
<tr>
<td>1901</td>
<td>American engineer Peter Cooper Hewitt invented Fluorescent lamp.</td>
</tr>
<tr>
<td>1904</td>
<td>English engineer John Ambrose Fleming invented diode.</td>
</tr>
<tr>
<td>1906</td>
<td>American inventor Lee de Forest invented triode.</td>
</tr>
<tr>
<td>1908</td>
<td>Scottish engineer Alan Archibald Campbell-Swinton, laid the principles of Television.</td>
</tr>
<tr>
<td>1911</td>
<td>Dutch physicist Heike Kamerlingh Onnes discovered Superconductivity.</td>
</tr>
<tr>
<td>1912</td>
<td>American engineer Edwin Howard Armstrong developed Electronic oscillator.</td>
</tr>
<tr>
<td>1915</td>
<td>French physicist Paul Langevin and Russian engineer Constantin Chilowsky invented sonar.</td>
</tr>
<tr>
<td>1917</td>
<td>American engineer Alexander M. Nicholson invented crystal oscillator.</td>
</tr>
<tr>
<td>1918</td>
<td>French physicist Henri Abraham and Eugene Bloch invented multivibrator.</td>
</tr>
<tr>
<td>1919</td>
<td>Edwin Howard Armstrong developed standard AM radio receiver.</td>
</tr>
<tr>
<td>1921</td>
<td>Metre Convention was extended to include the electrical units.</td>
</tr>
<tr>
<td>1921</td>
<td>Edith Clarke invents the &quot;Clarke calculator&quot;, a graphical calculator for solving line equations involving hyperbolic function, allowing electrical engineers to simplify calculations for inductance and capacity in power transmission lines.</td>
</tr>
<tr>
<td>1924</td>
<td>Japanese engineer Kenjiro Takayanagi began research program on electronic television.</td>
</tr>
<tr>
<td>1925</td>
<td>Austrian American engineer Julius Edgar Lilienfeld patented the first FET (which became popular much later).</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
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<tr>
<td>------</td>
<td>----------------------------------------------------------------------</td>
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<tr>
<td>1926</td>
<td>Yagi-Uda antenna was developed by the Japanese engineers Hidetsugu Yagi and Shintaro Uda</td>
</tr>
<tr>
<td>1926</td>
<td>Japanese engineer Kenjiro Takayanagi demonstrated CRT television with 40-line resolution, the first working example of a fully electronic television receiver.</td>
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<tr>
<td>1927</td>
<td>Japanese engineer Kenjiro Takayanagi increased television resolution to 100 lines, unrivaled until 1931</td>
</tr>
<tr>
<td>1927</td>
<td>American engineer Harold Stephen Black invented negative feedback amplifier</td>
</tr>
<tr>
<td>1927</td>
<td>German Physicist Max Dieckmann invented Video camera tube</td>
</tr>
<tr>
<td>1928</td>
<td>Raman scattering discovered by C. V. Raman and Kariamanickam Srinivasa Krishnan, providing basis for later Raman laser</td>
</tr>
<tr>
<td>1928</td>
<td>Japanese engineer Kenjiro Takayanagi was the first to transmit human faces in half-tones on television, influencing the later work of Vladimir K. Zworykin</td>
</tr>
<tr>
<td>1928</td>
<td>First experimental Television broadcast in the US.</td>
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<tr>
<td>1929</td>
<td>First public TV broadcast in Germany</td>
</tr>
<tr>
<td>1931</td>
<td>First wind energy plant in the Soviet Union</td>
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<tr>
<td>1934</td>
<td>Japanese engineer Akira Nakajima's switching circuit theory lays foundations for digital electronics</td>
</tr>
<tr>
<td>1936</td>
<td>Dudley E. Foster and Stuart William Seeley developed FM detector circuit.</td>
</tr>
<tr>
<td>1936</td>
<td>Austrian engineer Paul Eisler invented Printed circuit board</td>
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<tr>
<td>1936</td>
<td>Scottish Scientist Robert Watson-Watt developed the Radar concept which was proposed earlier.</td>
</tr>
<tr>
<td>1938</td>
<td>Russian American engineer Vladimir K. Zworykin developed Iconoscope</td>
</tr>
<tr>
<td>1939</td>
<td>Edwin Howard Armstrong developed FM radio receiver</td>
</tr>
<tr>
<td>1939</td>
<td>Russell and Sigurd Varian developed the first Klystron tube in the US.</td>
</tr>
<tr>
<td>1941</td>
<td>German engineer Konrad Zuse developed the first programmable computer in Berlin</td>
</tr>
<tr>
<td>1944</td>
<td>Scottish Engineer John Logie Baird developed the first color picture tube</td>
</tr>
<tr>
<td>1945</td>
<td>Transatlantic telephone cable</td>
</tr>
</tbody>
</table>
American engineers John Bardeen and Walter Houser Brattain together with their group leader William Shockley invented transistor.

Hungarian-British physicist Dennis Gabor invented Holography

French physicist Alfred Kastler invented MASER

First nuclear power plant in the US

Japanese engineer Jun-ichi Nishizawa invented avalanche photodiode

First fully transistorized computer in the US

Optical fiber invented by Indian physicist Narinder Singh Kapany

Japanese engineer Jun-ichi Nishizawa invented the semiconductor laser

American engineer Jack Kilby invented the integrated circuit (IC)

MOSFET (MOS transistor) invented by Mohamed Atalla and Dawon Kahng at Bell Labs

American engineer Theodore Harold Maiman developed a LASER

Nick Holonyak Jr. invented the LED

First home Videocassette recorder (VCR)

Electronic calculator

Fiber optic communication by Kao and Hockham

American scientist Richard Stanley Williams invented memristor which was proposed by Leon O. Chua in 1971

<table>
<thead>
<tr>
<th>Date</th>
<th>Invention/Discovery</th>
<th>Inventor(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1900</td>
<td>Old quantum theory</td>
<td>Planck</td>
</tr>
<tr>
<td>1905</td>
<td>Theory of relativity</td>
<td>Einstein</td>
</tr>
<tr>
<td>1918</td>
<td>Atomic transmutation</td>
<td>Rutherford</td>
</tr>
<tr>
<td>1932</td>
<td>Neutron</td>
<td>Chadwick</td>
</tr>
<tr>
<td>1932</td>
<td>Particle accelerator</td>
<td>Crockcroft and Walton</td>
</tr>
<tr>
<td>Year</td>
<td>Invention/Material</td>
<td>Inventor(s)</td>
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<tr>
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<tr>
<td>1935</td>
<td>Scanning electron microscope</td>
<td>Knoll</td>
</tr>
<tr>
<td>1937</td>
<td>Xerography</td>
<td>Carlson</td>
</tr>
<tr>
<td>1937</td>
<td>Oscillograph</td>
<td>Van Ardenne, Dowling, and Bullen</td>
</tr>
<tr>
<td>1950</td>
<td>Modem</td>
<td>MIT and Bell Labs</td>
</tr>
<tr>
<td>1950</td>
<td>Karnaugh mapping technique (digital logic)</td>
<td>Karnaugh</td>
</tr>
<tr>
<td>1952</td>
<td>Digital voltmeter</td>
<td>Kay</td>
</tr>
<tr>
<td>1954</td>
<td>Solar battery</td>
<td>Chapin, Fuller, and Pearson</td>
</tr>
<tr>
<td>1956</td>
<td>Transatlantic telephone cable</td>
<td>UK and U.S.</td>
</tr>
<tr>
<td>1957</td>
<td>Sputnik I satellite</td>
<td>Soviet Union</td>
</tr>
<tr>
<td>1957</td>
<td>Nuclear Missile</td>
<td>Kurchatov / Soviet Union</td>
</tr>
<tr>
<td>1957</td>
<td>FORTRAN programming language</td>
<td>Watson Scientific</td>
</tr>
<tr>
<td>1959</td>
<td>First one-piece plain paper photocopier (Xerox 914)</td>
<td>Xerox</td>
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<tr>
<td>1959</td>
<td>Veroboard (Stripboard)</td>
<td>Terry Fitzpatrick</td>
</tr>
<tr>
<td>1961</td>
<td>Electronic clock</td>
<td>Vogel and Cie, patented by Alexander Bain, Scottish clockmaker in 1840.</td>
</tr>
<tr>
<td>1963</td>
<td>First commercially successful audio compact cassette</td>
<td>Philips Corporation</td>
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<tr>
<td>1964</td>
<td>BASIC programming language</td>
<td>Kemeny and Kurtz</td>
</tr>
<tr>
<td>1964</td>
<td>Liquid-crystal display</td>
<td>George H. Heilmeier</td>
</tr>
<tr>
<td>late 1960s</td>
<td>First digital fax machine</td>
<td>Dacom</td>
</tr>
<tr>
<td>1969</td>
<td>UNIX operating system</td>
<td>AT&amp;T's Bell Labs</td>
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<tr>
<td>1970</td>
<td>First microprocessor (4004, 60,000 oper/s)</td>
<td>Intel</td>
</tr>
<tr>
<td>1970</td>
<td>First commercially available DRAM memory</td>
<td>IBM</td>
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<tr>
<td>1971</td>
<td>EPROM</td>
<td>N/A</td>
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<tr>
<td>1971</td>
<td>PASCAL programming language</td>
<td>Wirth</td>
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<tr>
<td>1971</td>
<td>First microcomputer-on-a-chip</td>
<td>Intel</td>
</tr>
<tr>
<td>1971</td>
<td>Laser printer</td>
<td>Xerox</td>
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<tr>
<td>1972</td>
<td>8008 processor (200 kHz, 16 kB)</td>
<td>Intel</td>
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<tr>
<td>1972</td>
<td>First programmable word processor</td>
<td>Automatic Electronic Systems</td>
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<tr>
<td>1972</td>
<td>5¼-inch diskette</td>
<td>N/A</td>
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<tr>
<td>1972</td>
<td>First modern ATM (IBM 2984)</td>
<td>IBM</td>
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<tr>
<td>1973</td>
<td>Josephson junction</td>
<td>IBM</td>
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<tr>
<td>1973</td>
<td>Tunable continuous-wave laser</td>
<td>Bell Labs</td>
</tr>
<tr>
<td>1973</td>
<td>Ethernet</td>
<td>Metcalfe</td>
</tr>
<tr>
<td>Year</td>
<td>Description</td>
<td>Inventor/Creator</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------------------------------------------------</td>
<td>-------------------------------------------------------</td>
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<tr>
<td>1973</td>
<td>Mobile phone</td>
<td>John F. Mitchell and Dr. Martin Cooper of Motorola</td>
</tr>
<tr>
<td>1974</td>
<td>C (programming language)</td>
<td>Kernighan, Ritchie</td>
</tr>
<tr>
<td>1974</td>
<td>Programmable pocket calculator</td>
<td>Hewlett-Packard</td>
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<tr>
<td>1975</td>
<td>BASIC for personal computers</td>
<td>Allen</td>
</tr>
<tr>
<td>1975</td>
<td>First personal computer (Altair 8800)</td>
<td>Roberts</td>
</tr>
<tr>
<td>1975</td>
<td>Digital camera</td>
<td>Steven Sasson of Eastman Kodak</td>
</tr>
<tr>
<td>1975</td>
<td>Integrated optical circuits</td>
<td>Reinhart and Logan</td>
</tr>
<tr>
<td>1975</td>
<td>Omni-font optical character recognition system</td>
<td>Nuance Communications</td>
</tr>
<tr>
<td>1975</td>
<td>CCD flatbed scanner</td>
<td>Kurzweil Computer Products</td>
</tr>
<tr>
<td>1975</td>
<td>Text-to-speech synthesis</td>
<td>Kurzweil Computer Products</td>
</tr>
<tr>
<td>1975</td>
<td>First commercial reading machine for the blind (Kurzweil Reading Machine)</td>
<td>Kurzweil Computer Products</td>
</tr>
<tr>
<td>1976</td>
<td>Apple I computer</td>
<td>Wozniak, Jobs</td>
</tr>
<tr>
<td>1977</td>
<td>Launch of the &quot;1977 trinity computers&quot; expanding home computing, the Apple II, Commodore PET and the TRS-80</td>
<td>Apple, Tandy Corporation, Commodore Business Machines</td>
</tr>
<tr>
<td>1977</td>
<td>First handheld electronic game (Auto Race)</td>
<td>Mattel</td>
</tr>
<tr>
<td>1978</td>
<td>WordPerfect 1.0</td>
<td>Satellite Software</td>
</tr>
<tr>
<td>1980</td>
<td>3½-inch floppy (2-sided, 875 kB)</td>
<td>N/A</td>
</tr>
<tr>
<td>1980</td>
<td>VIC-20</td>
<td>Commodore Business Machines</td>
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<tr>
<td>1981</td>
<td>IBM Personal Computer (8088 processor)</td>
<td>IBM</td>
</tr>
<tr>
<td>1981</td>
<td>MS-DOS 1.0</td>
<td>Microsoft</td>
</tr>
<tr>
<td>1981</td>
<td>&quot;Wet&quot; solar cell</td>
<td>Bayer AG</td>
</tr>
<tr>
<td>1982</td>
<td>Commodore 64</td>
<td>Commodore Business Machines</td>
</tr>
<tr>
<td>1982</td>
<td>First commercially marketed large-vocabulary speech recognition</td>
<td>Kurzweil Applied Intelligence and Dragon Systems</td>
</tr>
<tr>
<td>1983</td>
<td>First built-in hard drive (IBM PC XT)</td>
<td>IBM</td>
</tr>
<tr>
<td>1983</td>
<td>C++ (programming language)</td>
<td>Stroustrup</td>
</tr>
<tr>
<td>1984</td>
<td>Macintosh computer (introduced)</td>
<td>Apple Computer</td>
</tr>
<tr>
<td>1984</td>
<td>CD-ROM player for personal computers</td>
<td>Philips</td>
</tr>
<tr>
<td>1984</td>
<td>First music synthesizer (Kurzweil K250) capable of recreating the grand piano and other orchestral instruments</td>
<td>Kurzweil Music Systems</td>
</tr>
</tbody>
</table>
1984 | Amiga computer (introduced) | Commodore
---|---|---
1985 | 300,000 simultaneous telephone conversations over single optical fiber | AT&T, Bell Labs
1987 | Warmer superconductivity | Karl Alex Mueller
1987 | 80386 microprocessor (25 MHz) | Intel
1989 | First commercial handheld GPS receiver (Magellan NAV 1000) | Magellan Navigation Inc.
1989 | Silicon-germanium transistors | IBM fellow Bernie Meyerson
1990 | 486 microprocessor (33 MHz) | Intel
1993 | Weather Control Device / HAARP | U.S.
1994 | Pentium processor, P5-based (60/90 MHz, 166.2 MIPS) | Intel
1994 | Bluetooth | Ericsson
1994 | First DVD player ever made | Tatung Company
1996 | Alpha 21164 processor (550 MHz) | Digital Equipment
1996 | P2SC processor (15 million transistors) | IBM

**Consumer Electronics**

**1843-1923: From electromechanics to electronics**

- 1843: Watchmaker Alexander Bain (inventor) develops the basic concept of displaying images as points with different brightness values.
- 1848: Frederick Collier Bakewell invents the first wirephoto machine, an early fax machine
- 1861: Grade school teacher Philipp Reis presents his telephone in Frankfurt, inventing the loudspeaker as a by-product.
- 1867: French poet and philosopher Charles Cros (1842 - 1888) presents the construction principle of a phonograph in his 'paréophone', which turned out not to be a commercial success at the time.
- 1867: James Clerk Maxwell (1831 - 1879) develops a theory predicting the existence of electromagnetic waves and establishes Maxwell's equations to describe their properties. Together with the Lorentz force law, these equations form the foundation for classical electrodynamics and classical optics as well as electric circuits.
- 1874: Ferdinand Braun discovers the rectifier effect in metal sulfides and metal oxides.
• 1877: Thomas Edison (1847 - 1931) invents the first phonograph, using a tin foil cylinder. For the first time sounds could be recorded and played. A phonograph horn with membrane and needle was arranged in such a way that the needle had contact to the tinfoil.

• 1880: the American physicist Charles Sumner Tainter discovers that many disadvantages of Edison's cylinders can be eliminated if the soundtrack is arranged in spiral form and engraved in a flat, round disk. Technical problems soon ended these experiments. Still, Tainter is regarded as the inventor of the gramophone record.

• 1884: Paul Nipkow obtains a patent for his Nipkow disk, an image scanning device that reads images serially, which constitutes the foundation for mechanical television. Two years later his patent runs out.

• 1886: Heinrich Hertz succeeds in proving the existence of electromagnetic waves for the first time - now the groundwork for wireless telegraphy and radio broadcasting in physical science is laid.

• 1887: Unaware of Charles Sumner Tainter's experiments, German-American Emil Berliner has his phonograph patented. He used a disk instead of a cylinder, primarily to avoid infringing on Edison's patent. Quickly it becomes obvious that flat Gramophone records are easier to duplicate and store.

• 1888:
  - Alexander Graham Bell (1847 - 1922) significantly reduces interfering noises by using a wax cylinder instead of tin foil. This paves the way to commercial success for the improved phonograph.
  - American Oberlin Smith describes a process to record audio using a cotton thread with integrated fine wire clippings. This makes reel-to-reel audio tape recording possible.

• 1890:
  - The phonograph becomes faster and more convenient due to an electric motor. The electric motor brings on the first juke box with cylinders - even before flat disk records were widely available.
  - Thomas Edison discovers thermionic emission. To this day, this effect forms the basis for the vacuum tube and the cathode ray tube.

• approximately 1893: The invention of the selenium phototube allows the conversion of brightness values into electrical signals. The principle is applied in wirephoto and television technology for a short time. Selenium is used in light meters for the next 50 years.

• 1895: Auguste Lumière's cinematograph displays moving images for the first time. In the same year, brothers Emil and Max Skladanowsky present their "Bioscop" in Berlin.

• 1897
  - Ferdinand Braun invents the "inertialess cathode ray oscillograph tube", a principle which remained unchanged in television picture tubes.
The Italian Guglielmo Marconi transmits wireless telegraph messages by electromagnetic waves over a distance of five kilometers.

1898
- The Danish physicist Valdemar Poulsen creates the world's first magnetic recording and reproduction, using a 1 mm thick steel wire as a magnetizable carrier.
- Nikola Tesla demonstrated the first wireless remote control of a model ship.

1899: The dog "Nipper" is used in "His Master's Voice", the trademark for gramophones and records.

1902
- Otto von Bronk patented his "Method and apparatus for remote visualization of images and objects with temporary resolution of the images in parallel rows of dots". This patent, originally developed for phototelegraphy, impacted the development of color television, particularly the NTSC implementation.
- For the first time audio records are printed with paper labels in the middle.

1903: Guglielmo Marconi provides evidence that wireless telegraphic communication is possible over long distances, such as across the Atlantic. He used a transmitter developed by Ferdinand Braun.

1904
- For the first time, double-sided records, and those with a diameter of 30 cm are produced, increasing playing time up to 11 minutes (5.5 minutes per side). These are created by Odeon in Berlin and debuted at the Leipzig Spring Fair.
- The German physicist Arthur Korn developed the first practical method for telegraphy.

1905: The Englishman Sir John Ambrose Fleming invents the first electron tube.

1906
- Robert von Lieben patented his "inertia working cathode-ray-relays". By 1910 he developed this into the first real tube amplifier, by creating a triode. His invention of the triode is almost simultaneously created by the American Lee de Forest.
- Max Dieckmann and Gustav Glage use the Braun tube for playback of 20-line black-and-white images.
- The first jukebox with records comes on the market.
- American Brigadier General Henry Harrison Chase Dunwoody files for a patent for a carborundum steel detector for use in a crystal radio, an improved version of the Cat's-whisker detector. It is sometimes credited as the first semiconductor in history. The envelope detector is an important part of every radio receiver.

1907: Rosenthal puts in his image telegraph for the first time a photocell.

1911: First film studios are created in Hollywood and Potsdam- Babelsberg.
• 1912: The first radio receiver is created, in accordance with the Audion principle.

• 1913: The legal battle over the invention of the electron tube between Robert von Lieben and Lee de Forest is decided. The electron tube is replaced by a high vacuum in the glass flask with significantly improved properties.
  o Alexander Meissner patented his process "feedback for generating oscillations", by his development of a radio station using an electron tube.
  o The Englishman Arthur Berry submits a patent on the manufacture of printed circuits by etched metal.

• 1915: Carl Benedicks leads basic studies in Sweden on the electrical properties of silicon and germanium. Due to the emerging tube technology, however, interest in semiconductors remains low until after the Second World War.

• 1917
  o Based on previous findings of the Englishman Oliver Lodge, the Frenchman Lucien Levy develops a radio receiver with frequency tuning using a resonant circuit.

• 1919: Charlie Chaplin founded the Hollywood film production and distribution company United Artists

• 1920: The first regularly operating radio station KDKA goes on air on 2 November 1920 in Philadelphia, USA. It is the first time electronics are used to transmit information and entertainment to the public at large. The same year in Germany an instrumental concert was broadcast on the radio from a long-wave transmitter in Wusterhausen.

• 1922: J. McWilliams Stone invents the first portable radio receiver. George Frost builds the first "car radio" in his Ford Model T.

• 1923
  o The 15-year-old Manfred von Ardenne is granted his first patent for an electron tube having a plurality of electrodes. Siegmund Loewe (1885-1962) builds with the tube his first radio receiver "Loewe Opta-".
  o The Hungarian engineer Dénes Mihály patented an image scanning with line deflection, in which each point of an image is scanned ten times per second by a selenium cell.
  o August Karolus (1893-1972) invents the Kerr cell, an almost inertia-free conversion of electrical pulses into light signals. He was granted a patent for his method of transmitting slides.
  o Vladimir Kosma developed the first television camera tube, the Ikonoskop, using the Braun tube.
  o The German State Secretary Karl August Bredow founded the first German broadcasting organization. By lifting the ban on broadcast reception and the opening of the first private radio station, the development of radio as a mass medium begins.
1924-1959: From cathode ray tube to stereo audio and TV

- 1924: the first radio receivers are exhibited at the Berlin Radio Show
- 1925
  - Brunswick Records in Dubuque, Iowa produced their first record player, the Brunswick Panatrope with a pickup, amplifier and loudspeaker
  - In the American Bell Laboratories, a method for recording of records obtained by microphone and tube amps for series production. Also in Germany working on it is ongoing since 1922. 1925 appear the first electrically recorded disks in both countries.
  - At the Leipzig Spring Fair, the first miniature camera "Leica" is presented to the public.
  - John Logie Baird performs the first screening of a living head with a resolution of 30 vertical lines using a Nipkow disk.
  - August Karolus demonstrated in Germany television with 48 lines and ten image changes per second.
- 1926
  - Edison developed the first "LP". By dense grooves (16 grooves on 1 mm) and the reduction of speed to 80 min^-1 (later 78 min^-1 ) increases the playing time up to 2 times 20 minutes. He carries himself with the decline of his phonograph business.
  - The German State Railroad offers a cordless telephone service in moving trains between Berlin and Hamburg - the idea of mobile telephony is born.
  - John Logie Baird developed the first commercial television set in the world. It was not until 1930, he is called a "telescreen sold" at a price of 20 pounds.
- 1927
  - The first fully electronic music boxes ("Jukeboxes") used in the USA on the market.
  - German Grammophon on sale due to a license agreement with the Brunswick-Balke-Collender Company. Its first fully electronic turntables.
  - The first industrially manufactured car radio, the "Philco Transitone" from the "Storage Battery Co." in Philadelphia, USA, comes on the market.
  - The first shortwave radio - Rundfunkübertragung overseas broadcast by the station PCJJ the Philips factories in Eindhoven in the Dutch colonies.
  - Opening of the first regular telegraphy-Dienstes between Berlin and Vienna.
  - First commercial sound films ("The Jazz Singer", USA) using the "Needle sound" back in sync with the film screening for LPs over loudspeakers.
  - First public television broadcasts in the UK by John Logie Baird between London and Glasgow and in the USA by Frederic Eugene Ives (1882-1953) between Washington and New York.
o The American inventor Philo Taylor Farnsworth (1906-1971) developed in Los Angeles, the first fully electronic television system in the world.

o John Logie Baird developed his Phonovision, the first videodisc player. 30-line television images are stored on shellac records. At 78 RPM mechanically scanned, the images can be played back on his "telescreen". It could not play sound nor keep up with the rapidly increasing resolution of television. More than 40 years later, commercial optical disc players came onto the market.

- 1928: Fritz Pfeumer got the first tape recorder patent. It replaces steel wire with paper coated in iron powder. According to Valdemar Poulsen (1898) to the second crucial pioneer of magnetic sound, image and data storage
  
o Dénes Mihály presented in Berlin a small circle, the first authentic television broadcast in Germany, having worked at least since 1923 in this field.

o August Karolus and the company Telefunken put on the "fifth Great German Radio Exhibition Berlin 1928" the prototype of a television receiver, with an image size of 8 cm × 10 cm and a resolution of about 10,000 pixels, a much better picture quality than previous devices.

o In New York (USA) the first regular television broadcasts of the experiment station WGY, operated by the General Electric Company (GE). Sporadic television news and dramas radiate from these stations by 1928.
  
  - The first commercially produced television receiver of the Daven Corporation in Newark is offered for $75.

o John Logie Baird transmits the first television pictures internationally, and the same across the Atlantic from London to New York. He also demonstrated the world's first color television transmission in London.

- 1929
  
o Edison withdraws from the phono business - the disk has ousted the cylinder.

o The company Columbia Records developed the first portable record player that can be connected to any tube radio. It also created the first radio / phonograph combinations, the precursor to the 1960s music chests.

- The German physicist Curt Stille (1873-1957) records magnetic sound for film, on a perforated steel band. First, this "Magnettonverfahren" has no success. Years later it is rediscovered for amateur films, providing easy dubbing. A "Daylygraph" or Magnettongerät had amplifier and equalizer, and a mature Magnettondiktiergerät called "Textophon".

- Based on patents, which he had purchased of silence, brings the Englishman E. Blattner the "Blattnerphone" "the first magnetic sound recording on the market. It records on a thin steel band.
The first sound film using optical sound premiers. Since the early 1920s, various people have developed this method. The same optoelectronic method also allows for the first time the post-processing of recorded music to sound recordings of it.

The director Carl Froelich (1875-1953) turns "The Night Belongs to Us", the first German sound film.

20th Century Fox presents in New York on an 8 m × 4 m big screen the first widescreen movie.

The radio station Witzleben begins in Germany with the regular broadcasting of television test broadcasts, initially on long wave with 30 lines (= 1,200 pixels) at 12.5 image changes per second. It appear first blueprints for television receiver.

John Logie Baird starts in the UK on behalf of the BBC with regular experimental television broadcasts to the public.

Frederic Eugene Ives transmits a color television from New York to Washington.

1930

- Manfred von Ardenne invented and developed the flying-spot scanner, Europe's first fully electronic television camera tube.
- In Britain, the first television advertising and the first TV interview

1931

- The British engineer and inventor Alan Dower Blumlein (1903-1942) invents "Binaural Sound", today called "Stereo". He developed the stereo record and the first three-way speaker. He makes experimental films with stereo sound. Then he becomes leader of the development team for the EMI -405-line television system.
- The company RCA Victor presents to the public the first real LP record, the 35 cm diameter and 33.33 RPM give sufficient playing time for an entire orchestral work. But the new turntables are initially so expensive that they are only gain broad acceptance after the Second World War - then as vinyl record.
- The French physicist René Barthélemy leads in Paris the first public television with clay before. The BBC launches first Tonversuche in the UK.
- Public World Premiere of electronic television - without electro-mechanical components such as the Nipkow disk - on the "eighth Great German Radio Exhibition Berlin 1931 ". Doberitz / Pomerania is the first German location for a tone-TV stations.
- Manfred von Ardenne can be the principle of a color picture tube patent: Narrow strips of phosphors in the three primary colors are closely juxtaposed arranged so that they complement each other with the electron flow to white light. A separate control of the three colors has not yet provided.

1932
The company AEG and BASF start for the magnetic tape method of Fritz Pfleumer to care (1928). They develop new devices and tapes, in which celluloid is used instead of paper as a carrier material.

In Britain, the BBC sends first radio programs time-shifted instead of live.

The company telephone and radio apparatus factory Ideal AG (today Blaupunkt) provides a car radio using Bowden cables to control it from the steering column.

- 1933
  - After the Nazi seizure of power in Germany is broadcasting finally a political tool. Systematic censorship is to prevent opposition and spread the "Aryan culture". Series production of the "People's recipient VE 301 "starts.
  - Edwin Howard Armstrong demonstrates that frequency-modulated (FM) radio transmissions are less susceptible to interference than amplitude-modulated (AM). However, practical application is long delayed.
  - In the USA the first opened drive-in theater.

- 1934: First commercial stereo recordings find little favor - the necessary playback devices are still too expensive. The term "High Fidelity" is embossed around this time.

- 1935
  - AEG and BASF place at the Berlin Radio Show, the tape recorder "Magnetophon K1 "and the appropriate magnetic tapes before. In case of fire in the exhibition hall all four exhibited devices are destroyed.
  - In Germany the world's first regular television program operating for about 250 mostly public reception points starts in Berlin and the surrounding area. The mass production of television receivers is - probably due to the high price of 2,500 Reichsmarks - not yet started.
  - At the same time, the research institute of the German Post (RPF) begins with development work for a color television methods, but which are later reinstated due to the Second World War.

- 1936
  - Olympic Games in Berlin broadcast live.
  - "Olympia suitcase", battery-powered portable radio receiver, introduced.
  - The first mobile television camera (180 lines, all-electronic) is used for live television broadcasts of the Olympic Games.
  - Also in the UK are first regular television broadcasts - now for the perfect electronic EMI system, which soon replaced the mechanical part Baird system - broadcast.
  - Video telephony connections between booths in Berlin and Leipzig. Later connections from Berlin to Nuremberg and Munich added.
The Frenchman Raymond Valtat reports on a patent, which describes the principle of working with binary numbers abacus.

Konrad Zuse works on a dual electromechanical computing machine that is ready in 1937.

1937
- First sapphire needle for records of the company Siemens
- The interlaced video method is introduced on TVr to reduce image flicker. The transmitter Witzleben uses the new standard with 441 lines and 25 image changes, i.e. 50 fields of 220 half-lines. Until the HDTV era the interlace method remains in use.
- First movie encoder make it possible not to send the TV live, but to rely on recordings.

1938
- The improved AEG tape-recorder "Magnetophon K4" is first used in radio studios. The belt speed is 77 cm / s, which at 1000 m length of tape has a playing time of 22 minutes.
- Werner Flechsig invents the shadow mask method for separate control of the three primary colors in a color picture tube.

1939
- On the "16th Great German Radio and television broadcasting exhibition Berlin 1939 ", the" German Unity television receiver E1 "and announces the release of free commercial television. Due to the difficult political and economic situation, only about 50 devices are sold instead of the planned 10,000.
- In the USA the first regular television broadcasts take place.

1940
- The development of television technology for military purposes increases the resolution to 1029 lines at 25 frames per second. Commercial HDTV television reached that resolution almost half a century later.
- The problem of band noise with tape devices is reduced dramatically by the invention of radio frequency bias of Walter Weber and Hans-Joachim von Braunmühl.

1942: The first all-electronic computer is used by John Vincent Atanasoff, but quickly fades into oblivion. Four years later the ENIAC completed - the beginning of the end of Electromechanics in computers and calculators.

1945-1947: American soldiers capture in Germany some tape recorders. This and the nullified German patents leads to the development of the first tape recorders in the United States. The first home device "Sound Mirror "by the Brush Development Co. is there on the market.

1948
- The American physicist and industrialist Edwin Herbert Land (1909-1991) launches the first instant camera, Polaroid camera Model 95 on the market.
Three American engineers at Bell Laboratories (John Bardeen, Walter Brattain and William Shockley) invent the transistor. Its lesser size and power compared with electron tubes brings (from 1955) portable radio receivers starting its march through all areas of electronics.

The Hungarian-American physicist Peter Carl Goldmark (1906-1977) invents the vinyl record (first published 1952), much less noisy than their predecessors shellac. Thanks to micro-groove (100 grooves per cm) can play 23 minutes per side. The LP record is born. This one is the redemption of the claim "high fidelity one step closer" to the end of the shellac era.

The Radio Corporation of America (RCA) leads the music format with 45 RPM records, later to conquer the market for cheap players. The first publication in Germany in this format appears 1953rd

The British physicist Dennis Gabor (1900-1979) invents holography. This method of recording and reproducing image with coherent light allows three-dimensional images. It was not until 1971 when the procedure gained practical importance, he received the Nobel Prize for Physics.

1949
- In Germany, FM broadcasting starts regular program operation.
- Experimentally since 1943, series production since 1949 there are for professional use stereo-Tonbandgeräte and matching ribbons. Also portable devices for reporters, initially propelled by a spring mechanism, has been around since 1949

1950
- In the USA the first prerecorded audio tapes are marketed.
- Also in the USA the company Zenith markets the first TV with cable remote control for channel selection.

1951
- The CBS (Columbia Broadcasting System) broadcasts in New York the first color television program in the world, but using the field sequential standard, not reaching to the resolution of the black and white television and was to be incompatible.
- With the "tape recorder F15 "from AEG 's first home tape recorder appears on the German market.
- RCA Electronic Music is the first synthesizer prior to the creation of artificial electronic sounds.

1952
- Reintroduction of regular television broadcasts in Germany after the Second World War.
- 20th Century Fox developed with "Cinemascope" the most successful wide-screen process to better compete with television. Only some 50 years later pulls the TV with the 16:9 size screen after.

1953
- The "National Television System Committee" (Abbreviated as NTSC) normalized in the USA named after her black-and-white-compatible NTSC -Farbfernseh process. A year later, this method is introduced in the United States.

- The car radio top model "Mexico" from Becker for the first time to an FM area (in mono) and an automatic tuning.

- 1954
  - RCA developed for the first apparatus for recording video signals on magnetic tapes. 22 km magnetic tape are needed per hour. By 1956, succeeds the company Ampex through the use of multiple tracks, the tape speed to more practicable 38.1 cm / s lower.
  - The European Broadcasting Union is founded "Euro Vision".
  - First regular television broadcasts in Japan.

- 1955
  - The second generation "TRADIC" (Transistorized Digital Computer), first to use only transistors therefore much smaller and more powerful than its predecessor tube computers.
  - The Briton Narinder Singh Kapany investigated the propagation of light in fine glass fibers (optical fibers).
  - The first wireless remote control for a television US-based Zenith consists of a better flashlight, with which one lights up in one of the four devices corners to turn the unit on or off, change the channel or mute the sound.

- 1956
  - The company Metz introduces radio device type 409 / 3D. First mass production of printed circuit boards. This follows since the 1930s, several improvements to the manufacturing technology.
  - The company Ampex introduces the "VR 1000" the first video recorder. That same year, CBS uses it for the first magnetic video tape recording (VTR) from. Although other programs are produced in color since 1954, the VTR cannot record color.

- 1957: The Frenchman Henri de France (1911-1986) developed the first generation of color TV system SECAM, which avoids some of the problems of the NTSC method. The weaknesses of the SECAM system be fixed in later modifications of the standard for the most part.

- 1958
  - By merging the Edison patents and the Berliner, the Blumlein stereo recording method becomes commercially viable. The company Mercury Records launches the first stereo record on the market.
  - The company Ampex expands the video recorder with the Model "VR 1000 B" to give it color capability.
Timeline of alcohol fuel

Ethanol, an alcohol fuel, is an important fuel for the operation of internal combustion engines that are used in cars, trucks, and other kinds of machinery.

- Ethanol was first isolated from wine in approximately 1100 and was found to burn shortly thereafter. These early solutions distilled from wine-salt mixtures were referred to as *aqua ardens* (burning water) or *aqua flamens* (flaming water) and had such low alcohol content that they burned without producing noticeable heat. By the 13th century, the development of the cooling coil allowed the isolation of nearly pure ethanol by distillation.

- Ethanol has been used for lamp oil and cooking, along with plant and animal oils. Small alcohol stoves (also called "spirit lamps") were commonly used by travelers in the 17th century to warm food and themselves.

- **Before the American Civil War** many farmers in the United States had an alcohol still to turn crop waste into free lamp oil and stove fuel for the farmers' family use. Conflict over taxation was not unusual; one example was the Whiskey Rebellion in 1791.

- In **1826**, Samuel Morey uses alcohol in the first American internal combustion engine prototype.

- In the **1830s**, alcohol blends had replaced increasingly expensive whale oil in most parts of the country. It "easily took the lead as the illuminant" because it was "a decided improvement on other oils then in use."

- By **1860**, thousands of distilleries churned out at least 90 million US gallons (340,000 m³) of alcohol per year for lighting. Camphene / alcohol blends (at $.50 per gallon) were cheaper than whale oil ($1.30 to $2.50 per gallon) and lard oil (90 cents per gallon). It was about the same price as coal oil, which was the product first marketed as "kerosene."

- In **1860**, German inventor Nicolaus Otto uses ethyl alcohol as a fuel in an early internal combustion engine.

- In **1862** and **1864**, a tax on alcohol was passed in the U.S. to pay for the Civil War, increasing the price of ethanol to over $2.00 per gallon. A new product from petroleum, called kerosene, is taxed at 10 cents a gallon.

- In the 19th century, spirit lamps, pigeon lamps and others used a variety of blends of alcohol and oils in Europe. Alcohol powered not only automobiles and farm machinery but also a wide variety of lamps, stoves, heaters, laundry irons, hair curlers, coffee roasters and every conceivable household appliance. By one estimate, some 95,000 alcohol fueled stoves and 37,000 spirit lamps had been manufactured in Germany by 1902.

- By the **1890s**, alcohol-fueled engines are starting to be used in farm machinery in Europe, making countries more fuel independent. Research at the Experimental Mechanical Laboratory of Paris and at the Deutsche...
Landwirtschaftliche Gesellschaft in Berlin in the 1890s helped pave the way for expanded use of alcohol fuel.

- By 1896, horseless carriages (cars) were showing up on roads in Europe and the United States. Because gasoline is so cheap and abundant, and also because ethanol is taxed at a high level, early US automobiles are adapted to gasoline from the beginning. Racing cars, on the other hand, usually used ethanol (and other alcohols) because more power could be developed in a smaller, lighter engine. Charles Edgar Duryea builds the first U.S. gasoline powered car but is aware of Samuel Morey's ethanol fueled experimental car of 1826. Henry Ford's first car, the Quadracycle, is also built that year. The car runs on gasoline, but Ford is aware of experiments with ethanol in Germany, and subsequently backs the lifting of the U.S. tax on industrial uses of ethanol.

- In 1899, the German government taxed petroleum imports and subsidized domestic ethanol. Kaiser Wilhelm II "was enraged at the Oil Trust of his country, and offered prizes to his subjects and cash assistance ... to adapt [alcohol] to use in the industries."

- In 1901, the French ministry of agriculture offered prizes for the best alcohol-fueled engines and household appliances.

- In 1902, the Paris alcohol fuel exposition exhibited alcohol powered cars, farm machinery, lamps, stoves, heaters, laundry irons, hair curlers, coffee roasters, and every conceivable household appliance and agricultural engine powered by alcohol. This exhibit traveled widely through Europe and was featured at the 1907 Jamestown, Virginia tricentennial celebrations.

- In 1906, the Free Alcohol bill is passed. The USA repeals the alcohol tax under Teddy Roosevelt. At 14 cents per US gallon, corn ethanol was cheaper than gasoline at 22 cents per US gallon. Bills pass that exempt farm stills from government control. In backing the bill, U.S. President Teddy Roosevelt says: "The Standard Oil Company has, largely by unfair or unlawful methods, crushed out home competition... It is highly desirable that an element of competition should be introduced by the passage of some such law as that which has already passed in the House, putting alcohol used in the arts and manufacturers upon the [tax] free list."

- Starting in 1901, the discovery of new oil fields in Texas causes the price of gasoline to drop to between 18 and 22 cents per US gallon by 1906, undercutting farm ethanol markets

- In 1908, the Ford Model T is introduced. Early models had adjustable carburetors to run on ethanol with gasoline as an option.

- In 1909, the U.S. Geological Survey reports: "In regard to general cleanliness, such as absence of smoke and disagreeable odors, alcohol has many advantages over gasoline or kerosene as a fuel... The exhaust from an alcohol engine is never clouded with a black or grayish smoke." Overall, alcohol was "a more ideal fuel than gasoline."
In 1914, the Free Alcohol bill is amended again to decrease the regulatory burden and encourage alcohol fuel production in the U.S.

In 1917 Alexander Graham Bell says: "Alcohol makes a beautiful, clean and efficient fuel… Alcohol can be manufactured from corn stalks, and in fact from almost any vegetable matter capable of fermentation… We need never fear the exhaustion of our present fuel supplies so long as we can produce an annual crop of alcohol to any extent desired."

In 1918, Scientific American says it is "now definitely established that alcohol can be blended with gasoline to produce a suitable fuel …" Another article notes that the Pasteur Institute of France found it could obtain 10 US gallons (38 L) of ethanol per ton of seaweed.

In 1919, Prohibition of beverage alcohol in the U.S. leads to suggestions for more ethanol use as an anti-knock blend with gasoline. Farm belt politicians are split on ethanol as a fuel. While distillers could have a new market for their alcohol, some thought that allowing any distillery to stay open would be a "bargain with the devil."

In the 1920s and 1930s, Koolmotor, Benzalcool, Moltaco, Lattybentyl, Natelite, Alcool and Agrol are some of the gasoline-ethanol blends of fuels once found in Britain, Italy, Hungary, Sweden, South Africa, Brazil and the USA (respectively).

In 1920, David White, chief geologist of US Geological Survey, estimates total oil remaining in the US at 6.7 billion barrels (1.07×10^9 m³). "In making this estimate, which included both proved reserves and resources still remaining to be discovered, White conceded that it might well be in error by as much as 25 percent."

In 1921, leaded gasoline is developed at the General Motors research laboratories in Dayton, Ohio. GM researcher Thomas Midgley, Jr. still maintains: "The most direct route which we now know for converting energy from its source, the sun, into a material that is suitable for use in an internal combustion motor is through vegetation to alcohol… It now appears that alcohol is the only liquid from a direct vegetable source that combines relative cheapness with suitability (although other sources might be found)... Alcohol will stand very high initial compressions without knocking, and at high compressions is smooth and highly satisfactory.".

In 1921, British engineer Harry Ricardo patents racing fuels RD1 and RD2 (for Ricardo Discol) that contained methanol and ethanol, acetone and small amounts of water. These were widely used on race tracks throughout Europe and the US in the 1920s and 30s.

In 1923 leaded gasoline is marketed, and by 1924 GM and Standard Oil Co. form the Ethyl Corp. Ethyl claims it has "solved" the problem of engine knock, but public health scientists (e.g. Alice Hamilton of Harvard University) are appalled at the prospects for lead poisoning and insist that alternatives such as ethanol blends are available.
In 1923 Rolls-Royce engine designer Harry Ricardo writes: "...It is a matter of absolute necessity to find an alternative fuel. Fortunately, such a fuel is in sight in the form of alcohol; this is a vegetable product whose consumption involves no drain on the world’s storage and which, in tropical countries at all events, can ultimately be produced in quantities sufficient to meet the world’s demand, at all events at the present rate of consumption. By the use of a fuel derived from vegetation, mankind is adapting the sun’s heat to the development of motive power, as it becomes available from day to day; by using mineral fuels, he is consuming a legacy – and a limited legacy at that – of heat stored away many thousands of years ago. In the one case he is, as it were, living within his income, in the other he is squandering his capital. It is perfectly well known that alcohol is an excellent fuel, and there is little doubt but that sufficient supplies could be produced within the tropical regions of the British empire…"

In 1923, the price of alcohol from molasses was less than 20 cents per US gallon, while retail gasoline prices had reached an all-time high of 28 cents per gallon. Standard Oil experiments with a 10% alcohol, 90% gasoline blend for a few months to increase octane and stop engine knock.

In 1923, French assembly passes the Carburant National law requiring gasoline importers to buy alcohol for 10% blends from the State Alcohol Service. The law has a far-reaching impact as many other nations, especially Brazil and other sugar-cane growing countries, were influenced to enact similar laws based on the French and German programs.

By the mid-1920s, ethyl alcohol is blended with gasoline in every industrialized nation, and some blends are showing up as experiments in the United States, but the market is dominated by leaded gasoline.

In October of 1924, a catastrophic miscalculation in the production of leaded gasoline causes at least 17 refinery deaths and many dozens of permanently debilitating injuries. GM and Standard very nearly abandon leaded gasoline, but decide to defend it, claiming (contrary to their own prior published research) that ""So far as science knows at the present time, tetraethyl lead is the only material available which can bring about these [antiknock] results."

In 1925, Henry Ford tells The New York Times that ethyl alcohol is "the fuel of the future" which "is going to come from fruit like that sumach out by the road, or from apples, weeds, sawdust -- almost anything. There is fuel in every bit of vegetable matter that can be fermented. There's enough alcohol in one year's yield of an acre of potatoes to drive the machinery necessary to cultivate the fields for a hundred years."

In 1926, US Public Health Service allows leaded gasoline to return to the market.

In 1928 Harry Ricardo, National Distillers Co. and Shell Oil introduce an alcohol fuel blend in the United Kingdom called "Cleveland Discol." The ethanol blend is a popular unleaded gasoline brand and is sold through 1968.

In August 1930, the German government required all gasoline importers to buy 2.5% of the volume of their imports from the German Alcohol Monopoly, and the ratio was increased to 6% and then 10% by 1932. Estimates of alcohol used in 1932 vary from 44 million liters to about 175 million liters. Some 36,000 small farm alcohol stills, owned by the monopoly, were in operation at this time. By 1938, Germany was
producing about 267 million liters of ethanol, about two thirds from potatoes and the rest from grain, wood sulfite liquors and beets. Some 89 million liters of methanol were produced from coal, while other synthetic fuels included 550 million liters of benzene and over one billion liters of synthetic gasoline. All told, 54% of the pre-war German fuel production was derived from non-petroleum sources, of which 8% was ethanol from renewable sources.

- In the 1930s, the Dust bowl drought and Great Depression forced many more farmers to move to the cities looking for work, leaving their alcohol fuel stills behind. Henry Ford, a farmer himself, supported ethanol's use over gas.

- In 1933, faced with the 25% unemployment of the Great Depression, the European concept of finding new markets for surplus farm products is widely discussed, with ethanol-gasoline blending among the most significant. Fuel blending experiments begin in Peoria, IL, Spokane WA, Lincoln, NE, and Ames, IA. Federal and state governments consider tax advantages to help ethanol production and increase employment among farmers. By 1935 the Chemurgy movement emerges, supported by farmers, Republicans, and Henry Ford. Along with ethanol, chemurgy research included the industrial development of agricultural raw materials such as hemp, soybeans and new products from biological materials, such as hemp & soybean plastics and inks.

- In 1933, a campaign to end Prohibition in the United States emerges. Concerned about renewed interest in ethanol for fuel, the American Petroleum Institute begins a campaign against ethanol blends, claiming such "will harm the petroleum industry and the automobile industry as well as state and national treasuries by reducing [oil] consumption," the sole beneficiaries allegedly being distillers, railroads (which would transport the alcohol) and bootleggers "to whom would be opened brand new fields of fraud." Prohibition ends with the passage of the Twenty-first Amendment to the United States Constitution on December 5, 1933.

- From 1933 to 1939, various oil companies and the American Petroleum Institute argued that tax incentives for ethanol would hurt the oil industry, reduce state treasuries, and create a bootlegger' atmosphere around fueling stations. They also claimed alcohol fuel was inferior to gasoline.

- In 1937, the farm chemurgy movement finds backers for the Agrol ethanol fuel plant, created at Atchison, Kansas. For two years, ethanol blends were sold at around 2,000 service stations in the U.S. Midwest. Agrol plant managers complained of sabotage and bitter infighting by the oil industry, and the cheaper price of gasoline. Agrol sold for 17 cents per gallon, while leaded gasoline sold for 16 cents.

- In 1939, Agrol production shuts down.

- In 1942, chemists who designed the Agrol ethanol plant, especially Leo Christensen, go to work producing ethanol for aviation fuel and synthetic "Buna-S" rubber for World War II. By 1944, petroleum based synthetic rubber production lags, and three quarters of all tires, raincoats, engine gaskets and other rubber products for the war effort come from ethanol.
In 1942, a war investigating committee led by then-Senator (and future president) Harry Truman makes public evidence that the oil industry had colluded with German chemical companies, especially I.G. Farben, to prevent the development of synthetic rubber production in the United States. Standard Oil (Exxon) had entered a partnership that it described as a "full marriage" designed to "outlast the war" no matter who won.

In 1949, S. J. W. Pleeth, chemist for the Cleveland Discol company in Great Britain, writes: "The bias aroused by the use of alcohol as a motor fuel has produced [research] results that are incompatible with each other ... Countries with considerable oil deposits -- such as the US -- or which control oil deposits of other lands -- such as Holland -- tend to produce reports antithetical to the use of fuels alternative to petrol; countries with little or no indigenous oil tend to produce favorable reports. The contrast ... is most marked. One can scarcely avoid the conclusion that the results arrived at are those best suited to the political or economic aims of the country concerned or the industry sponsoring the research. We deplore this partisan use of science, while admitting its existence, even in the present writer."

In 1964, a seven-car crash kills drivers Dave MacDonald and Eddie Sachs on the second lap of the Indianapolis 500, as over 150 US gallons (570 L) of gasoline burned. Johnny Rutherford, who was also involved in the crash, survived, mainly because his methanol-fueled car had not ignited. The United States Auto Club bans gasoline and switches all cars to methyl alcohol (methanol), a rule which would stay for 41 years before ending after the 2005 race.

During the Nigerian Civil War of 1967 to 1970, Engineers in the breakaway republic of Biafra resorted to powering vehicles with alcohol. Initially, alcohol was used to supplement the crude oil refining capacity which the fledgling state had under its control, but as the Soviet and UK backed Nigerian army seized the oil producing regions, and with the Nigerian embargo beginning to bite, alcohol became the dominant source of fuel for the economy.

In 1971, the Nebraska Agricultural Products Industrial Utilization Committee (or "Gasohol" Committee) is formed to find new uses for surplus grain. The commission tests ethanol-gasoline blends in thousands of cars over millions of miles, proving that ethanol can be used as an octane-boosting additive to replace leaded gasoline.

In 1973, the Arab oil embargo creates a worldwide energy crisis, leading to intensified search for alternative energy sources. Also, in the same year, the government of Brazil starts the program "Pró-Álcool" in order to substitute gas-powered vehicles in favor of automobiles powered by ethanol. Such program would lead to the development of the first ethanol powered automobile motor in the world.

In 1979, President Jimmy Carter's administration creates federal incentives for ethanol production. Federal and state subsidies for ethanol amount to about $11 billion between 1979 and 2000, as compared to about $150 billion in tax credits for the oil industry (from 1968–2000), according to the General Accounting Office.
• By the mid-1980s, over 100 new corn alcohol production plants are built and over a billion US gallons of ethanol for fuel were sold per year. The ethanol program is controversial for several reasons, not the least of which was that the ethanol industry was dominated by one company – Archer Daniels Midland of Peoria, Ill.

• In 1984, the number of ethanol plants peaked at 163 in the U.S., producing 595 million US gallons (2,250,000 m³) of ethanol that year.

• In 1988, the George H. W. Bush administration proposes a cleanup of "air toxics" in gasoline, focusing on replacing benzene octane boosters with ethanol. The proposal leads to one part of the 1990 Clean Air Act.

• In the late 1980s and 1990s, an oil surplus drives gasoline prices down as low as $12 per barrel, driving most of the ethanol industry into bankruptcy.

• In 1990 and 1992, Congress passes amendments to the Clean Air Act encouraging the use of ethanol and other oxygenated fuels as replacements for benzene, toluene and xylene octane boosters. MTBE becomes the oil industry's favorite additive, but as water pollution problems were recognized, MTBE is banned in California. Ethanol production rises to the 4-billion-US-gallon (15,000,000 m³) level.

• Between 1997 and 2002, three million U.S. cars and light trucks are produced which could run on E85, a blend of 85% ethanol with 15% gasoline. Almost no gas stations sell this fuel however.

• In the early 2000s, the invasion of Iraq makes Americans aware of their dependence on foreign oil. This and worry over anthropogenic climate change causes leading alternative energies like biofuel, solar and wind to expand 20 to 30% yearly.

• In 2003, California is the first state to ban MTBE. Several other states start switching soon afterward. California consumes 900 million US gallons (3,400,000 m³) of ethanol a year, about a third of all the ethanol produced in the United States.

• In 2004, Crude oil prices rise by 80%. Gasoline prices rise 30% in the U.S. Diesel fuel rises almost 50%. These rises are caused by hurricane damage to oil rigs in the Gulf of Mexico, attacks on Iraqi oil pipelines, disruptions elsewhere, and rising demand for gasoline in Asia, as Asians buy more cars. Alcohol fuel prices are much closer to the price of gasoline. The ethanol industry in the USA makes 225,000 barrels (35,800 m³) per day in August, an all-time record. Some conventional oil fuel companies are investing in alcohol fuel. Oil reserves are forecast to last about 40 more years. Total use (demand) of ethanol is 3.53 billion US gallons (13,400,000 m³).

• In 2005, E85 sells for 45 cents (or 30-75 cents wholesale) less than gasoline on average in the United States. More than 4 million flexible-fuel (capable of running on E85 as well as gasoline) vehicles exist in the United States. About 400 filling stations exist in the US that sell E85 fuel, mostly in the Midwest. Gasoline prices rise as ethanol prices stay the same, due to rapidly growing ethanol supply and federal tax subsidies for ethanol. Wholesale ethanol prices drop nearly 30% between January and April, or $1.75 to $1.23 per gallon in the U.S.
• In 2005, the earliest-documented test of driving a car designed solely for gasoline use, long-distance solely on 100% butanol fuel occurs as American motorist David Ramey drove from Blacklick, Ohio to San Diego, California using 100% butanol in an unmodified 1992 Buick Park Avenue.

• In 2006, the Indy Racing League switches to a 10% ethanol-90% methanol fuel mixture, as part of a phase-in to an all-ethanol formula in 2007. Bill Gates buys a quarter of Pacific Ethanol Inc. for $84 million.

• In 2007, United Nations Food and Agriculture Organization Special Rapporteur for the Right to Food urges five-year moratorium on food based biofuels, including ethanol, saying its development is a "crime against humanity." The UN Food and Agriculture Organization (FAO) calls this "regrettable," and UN secretary-general Ban Ki-Moon, called for more scientific research. "Clearly biofuels have great potential for good and, perhaps, also for harm."

• In 2008, Bill Gates sells most Pacific shares held by Cascade Investment for a loss of $38.9 million.

**Timeline of agriculture and food technology**

**Paleolithic**

• 30,600 BC – Pestle used as a tool in southern Italy to grind oats.

**Neolithic Revolution**

• 8,500 BC – Neolithic Revolution, the first agricultural revolution, begins in the ancient Near East
• 8,000 BC – was domesticated wheat at PPNA sites in the Levant.
• 7500 BC – PPNB sites across the Fertile Crescent growing wheat, barley, chickpeas, peas, beans, flax and bitter vetch. Sheep and goat domesticated.
• 7000 BC – agriculture had reached southern Europe with evidence of emmer and einkorn wheat, barley, sheep, goats, and pigs suggest that a food producing economy is adopted in Greece and the Aegean.
• 7000 BC – Cultivation of wheat, sesame, barley, and eggplant in Mehrgarh (modern day Pakistan).
• 7000 BC – Domestication of cattle and chicken in Mehrgarh, modern day Pakistan.
• 6800 BC – Rice domesticated in southeast Asia.
• 6500 BC – Evidence of cattle domestication in Turkey. Some sources say this happened earlier in other parts of the world.
• 6001 BC – Archaeological evidence from various sites on the Iberian peninsula suggest the domestication of plants and animals.
- 6000 BC – Granary built in Mehrgarh for storage of excess food.
- 5500 BC – Céide Fields in Ireland are the oldest known field systems in the world, this landscape consists of extensive tracts of land enclosed by brick walls.
- 5200 BC – In the heart of the Sahara Desert, several native species were domesticated, most importantly pearl millet, sorghum and cowpeas, which spread through West Africa and the Sahel. At this time the Sahara was covered in grassland that received plenty of rainfall, it was far more moist and densely populated than today.
- 4000 BC – In Mehrgarh, the domestication of numerous crops, including peas, sesame seeds, dates, and cotton, as well as a wide range of domestic animals, including the Domestic Asian Water Buffalo, an animal that remains essential to intensive agricultural production throughout Asia today.
- 4000 BC – Egyptians discover how to make bread using yeast
- 4000 BC – Evidence for rice domestication in the Khorat Plateau area of northwestern Thailand.
- 4000 BC – First use of light wooden ploughs in Mesopotamia (Modern day Iraq)
- 3500 BC – Irrigation was being used in Mesopotamia (Modern day Iraq)
- 3500 BC – First agriculture in the Americas, around Central Amazonia or Ecuador
- 3000 BC – Turmeric, cardamom, pepper and mustard are harvested in the Indus Valley Civilization.
- 3000 BC – Fermentation of dough, grain, and fruit juices is in practice.
- 3000 BC – Sugar produced in India

Antiquity

- 2600 BC – Large-scale commercial timbering of cedars in Phoenicia (Lebanon) for export to Egypt and Sumeria. Similar commercial timbering in South India.
- 1700 BC – Wind powered machine developed by the Babylonians
- 1500 BC: Seed drill in Babylonia
- 1300 BC – Creation of canal linking the Nile delta to the Red Sea
- 691 BC – First aqueduct (approx. 50 miles long) constructed to bring water to Nineveh.
- 530 BC – Tunnel of Eupalinos first underground aqueduct
- 500 BC – The moldboard iron plough is invented in China
- 500 BC – Row cultivation of crops using intensive hoeing to weed and conserve moisture practised in China
- 300 BC – Efficient trace harness for plowing invented in China
- 200 BC – Efficient collar harness for plowing invented in America
• 100 BC – Rotary winnowing fan invented in China
• 100 BC – The multi-tube seed drill is invented in China
• AD 200 – The fishing reel invented in China
• 600 – The distillation of alcohol in China
• 607 – The Chinese begin constructing a massive canal system to connect the Yellow and Yangtze rivers

**Modern technological advances**

• 1700 – British Agricultural Revolution ends
• 1804 - Vincenzo Dandolo writes several treatises of agriculture and sericulture.
• 1809 – French confectioner Nicolas Appert invents canning
• 1837 – John Deere invents steel plough
• 1763 – International "Potato Show" in Paris with corn varieties from different states
• 1866 – Gregor Mendel publishes his paper describing Mendelian inheritance
• 1871 – Louis Pasteur invents pasteurization
• 1895 – Refrigeration for domestic and commercial drink preservation introduced in the United States and the United Kingdom, respectively.
• 1913 - The Haber process, also called the Haber–Bosch process, made it possible to produce ammonia, and thereby fertilize, on an industrial scale.
• 1960 – First use with aerial photos in Earth sciences and agriculture.

**Green Revolution**

• 1944 – Green Revolution begins in Mexico
• 1974 – China creates the first hybrid rice. See Yuan Longping.
• 2000 – Genetically modified plants cultivated around the world.
• 2005 – Lasers used to replace stickers by writing on food to "track and trace" and identify individual pieces of fresh fruit.

**Timeline of snowflake research**
BC to 1900

- 150 BCE or 135 BCE - Han Ying (韓嬰) compiled the anthology *Han shi waizhuan*, which includes a passage that contrasts the pentagonal symmetry of flowers with the hexagonal symmetry of snow. This is discussed further in the *Imperial Readings of the Taiping Era*.
- 1250 - Albertus Magnus offers what is believed to be the oldest detailed description of snow.
- 1555 - Olaus Magnus publishes the earliest snowflake diagrams in *Historia de gentibus septentrionalibus*.
- 1611 - Johannes Kepler, in *Strenaeus De Nive Sexangula*, attempts to explain why snow crystals are hexagonal.
- 1637 - René Descartes' *Discourse on the Method* includes hexagonal diagrams and a study for the crystallization process and conditions for snowflakes.
- 1660 - Erasmus Bartholinus, in his *De figura nivis dissertatio*, includes sketches of snow crystals.
- 1665 - Robert Hooke observes snow crystals under magnification in *Micrographia*.
- 1675 - Friedrich Martens, a German physician, catalogues 24 types of snow crystal.
- 1681 - Donato Rossetti categorizes snow crystals in *La figura della neve*.
- 1778 - Dutch theologian Johannes Florentius Martinet diagrams precise sketches of snow crystals.
- 1796 - Shiba Kōkan publishes sketches of ice crystals under a microscope.
- 1820 - William Scoresby's *An account of the Arteic Regions* includes snow crystals by type.
- 1832 - Doi Toshitsura describes and diagrams 86 types of snowflake (雪華図說).
- 1837 - Suzuki Bokushi (鈴木牧之) publishes *Hokuetsu Seppu*.
- 1840 - Doi Toshitsura expands his categories to include 97 types.
- 1855 - James Glaisher publishes detailed sketches of snow crystals under a microscope.
- 1865 - Frances E. Chickering publishes *Cloud Crystals - a Snow-Flake Album*.
- 1870 - Adolf Erik Nordenskiöld identifies "cryoconite holes."
- 1891 - Friedrich Umlauf publishes *Das Luftmeer*.
- 1893 - Richard Neuhauss photographs a snowflake under a microscope, titled *Schneekrystalle*.
- 1894 - A. A. Sigson photographs snowflakes under a microscope.

1901 to 2000

1903 - Svante Arrhenius describes crystallization process in *Lehrbuch der Kosmischen Physik*.

1904 - Helge von Koch discover the fractal curves to be a mathematical description of snowflakes.

1931 - Wilson Bentley and William Jackson Humphreys publish *Snow Crystals*

1936 - Ukichiro Nakaya creates snow crystals and charts the relationship between temperature and water vapor saturation, later called the *Nakaya Diagram*.

1938 - Ukichiro Nakaya publishes *Snow* (雪)

1949 - Ukichiro Nakaya publishes *Research of snow* (雪の研究, *Yuki no kenkyū*)

1952 - Marcel R. de Quervain *et al.* define ten major types of snow crystals, including hail and graupel in IUGG for the Swiss Federal Institute for Snow and Avalanche Research.

1954 - Harvard University Press publishes Ukichiro Nakaya's *Snow Crystals: Natural and Artificial*.

1960 - Teisaku Kobayashi (小林禎作, *Kobayashi Teisaku*), verifies and improves the *Nakaya Diagram* with the *Kobayashi Diagram*.


1979 - Toshio Kuroda (黒田登志雄, *Kuroda Toshio*) and Rolf Lacmann, of the Braunschweig University of Technology, publish *Growth Mechanism of Ice from Vapour Phase and its Growth Forms*.


1988 - Norihiko Fukuta (福田矩彦, *Fukuta Norihiko*) et al. make artificial snow crystals in an updraft, confirming the *Nakaya Diagram*.

2001 and after

- 2002 - Kazuhiko Hiramatsu (平松和彦, *Hiramatsu Kazuhiko*) devises a simple snow crystal growth observatory apparatus using a PET bottle cooled by dry ice in an expanded polystyrene box.

- 2004 September - Akio Murai (村井昭夫, *Murai Akio*) invented the apparatus named lit. *Murai-method Artificial Snow Crystal producer* (Murai式人工雪結晶生成装置) which makes various shape of artificial snow crystals per pre-setting conditions meeting to *Nakaya diagram* by vapor generator and its cooling Peltier effect element.

- 2008 December - Yoshinori Furukawa (吉川義純, *Furukawa Yoshinori*) demonstrates conditional snow crystal growth in space, in *Solution Crystallization Observation Facility (SCOF)* on the JEM (Kibō), remotely controlled from Tsukuba Space Center of JAXA.
Timeline of mathematical innovation in South and West Asia

- **3rd millennium BCE Sexagesimal system of the Sumerians:**
- **2nd millennium BCE Babylonian Pythagorean triples.** According to mathematician S. G. Dani, the Babylonian cuneiform tablet Plimpton 322 written ca. 1850 BCE "contains fifteen Pythagorean triples with quite large entries, including (13500, 12709, 18541) which is a primitive triple, indicating, in particular, that there was sophisticated understanding on the topic" in Mesopotamia.
- **1st millennium BCE Baudhayana Śulba Sūtras Earliest statement of Pythagorean Theorem:**
  According to (Hayashi 2005, p. 363), the Śulba Sūtras contain "the earliest extant verbal expression of the Pythagorean Theorem in the world, although it had already been known to the Old Babylonians."

  The diagonal rope (aṅkṣayā-rajju) of an oblong (rectangle) produces both which the flank (pārśvamāni) and the horizontal (tiryāṇmāni) <ropes> produce separately.

  Since the statement is a sūtra, it is necessarily compressed and what the ropes produce is not elaborated on, but the context clearly implies the square areas constructed on their lengths, and would have been explained so by the teacher to the student.

Timeline of geometry

**Before 1000 BC**

- ca. 2000 BC – Scotland, Carved Stone Balls exhibit a variety of symmetries including all of the symmetries of Platonic solids.
- 1800 BC – Moscow Mathematical Papyrus, findings volume of a frustum
- 1650 BC – Rhind Mathematical Papyrus, copy of a lost scroll from around 1850 BC, the scribe Ahmes presents one of the first known approximate values of π at 3.16, the first attempt at squaring the circle, earliest known use of a sort of cotangent, and knowledge of solving first order linear equations

**1st millennium BC**

- 800 BC – Baudhayana, author of the Baudhayana Sulba Sutra, a Vedic Sanskrit geometric text, contains quadratic equations, and calculates the square root of 2 correct to five decimal places
- ca. 600 BC – the other Vedic “Sulba Sutras” (“rule of chords” in Sanskrit) use Pythagorean triples, contain of a number of geometrical proofs, and approximate π at 3.16
- 5th century BC – Hippocrates of Chios utilizes lunes in an attempt to square the circle
- 5th century BC – Apastamba, author of the Apastamba Sulba Sutra, another Vedic Sanskrit geometric text, makes an attempt at squaring the circle and also calculates the square root of 2 correct to five decimal places
- 530 BC – Pythagoras studies propositional geometry and vibrating lyre strings; his group also discover the irrationality of the square root of two,
- 370 BC – Eudoxus states the method of exhaustion for area determination
- 300 BC – Euclid in his Elements studies geometry as an axiomatic system, proves the infinitude of prime numbers and presents the Euclidean algorithm; he states the law of reflection in Catoptrics, and he proves the fundamental theorem of arithmetic
- 260 BC – Archimedes proved that the value of π lies between $3 + \frac{1}{7}$ (approx. 3.1429) and $3 + \frac{10}{71}$ (approx. 3.1408), that the area of a circle was equal to π multiplied by the square of the radius of the circle and that the area enclosed by a parabola and a straight line is $\frac{4}{3}$ multiplied by the area of a triangle with equal base and height. He also gave a very accurate estimate of the value of the square root of 3.
- 225 BC – Apollonius of Perga writes On Conic Sections and names the ellipse, parabola, and hyperbola,
- 150 BC – Jain mathematicians in India write the “Sthananga Sutra”, which contains work on the theory of numbers, arithmetical operations, geometry, operations with fractions, simple equations, cubic equations, quartic equations, and permutations and combinations
- 140 BC – Hipparchus develops the bases of trigonometry.

1st millennium

- ca. 340 – Pappus of Alexandria states his hexagon theorem and his centroid theorem
- 500 – Aryabhata writes the “Aryabhata-Siddhanta”, which first introduces the trigonometric functions and methods of calculating their approximate numerical values. It defines the concepts of sine and cosine, and also contains the earliest tables of sine and cosine values (in 3.75-degree intervals from 0 to 90 degrees)
- 7th century – Bhaskara I gives a rational approximation of the sine function
- 8th century – Virasena gives explicit rules for the Fibonacci sequence, gives the derivation of the volume of a frustum using an infinite procedure, and also deals with the logarithm to base 2 and knows its laws
- 8th century – Shridhara gives the rule for finding the volume of a sphere and also the formula for solving quadratic equations
820 – Al-Mahani conceived the idea of reducing geometrical problems such as doubling the cube to problems in algebra.

ca. 900 – Abu Kamil of Egypt had begun to understand what we would write in symbols as \( x^n \cdot x^m = x^{m+n} \)

975 – Al-Batani – Extended the Indian concepts of sine and cosine to other trigonometrical ratios, like tangent, secant and their inverse functions. Derived the formula: 
\[
\sin \alpha = \frac{\tan \alpha}{\sqrt{1 + \tan^2 \alpha}} \quad \text{and} \quad \cos \alpha = \frac{1}{\sqrt{1 + \tan^2 \alpha}}.
\]

1000–1500

ca. 1000 – Law of sines is discovered by Muslim mathematicians, but it is uncertain who discovers it first between Abu-Mahmud al-Khujandi, Abu Nasr Mansur, and Abu al-Wafa.

c. 1100 – Omar Khayyám “gave a complete classification of cubic equations with geometric solutions found by means of intersecting conic sections.” He became the first to find general geometric solutions of cubic equations and laid the foundations for the development of analytic geometry and non-Euclidean geometry. He also extracted roots using the decimal system (Hindu-Arabic numeral system).

1135 – Sharafeddin Tusi followed al-Khayyam’s application of algebra to geometry, and wrote a treatise on cubic equations which “represents an essential contribution to another algebra which aimed to study curves by means of equations, thus inaugurating the beginning of algebraic geometry.”

ca. 1250 – Nasir Al-Din Al-Tusi attempts to develop a form of non-Euclidean geometry.

15th century – Nilakantha Somayaji, a Kerala school mathematician, writes the “Aryabhatiya Bhasya”, which contains work on infinite-series expansions, problems of algebra, and spherical geometry

17th century

17th century – Putumana Somayaji writes the “Paddhati”, which presents a detailed discussion of various trigonometric series

1619 – Johannes Kepler discovers two of the Kepler-Poinsot polyhedra.

18th century

1722 – Abraham de Moivre states de Moivre's formula connecting trigonometric functions and complex numbers,

1733 – Giovanni Gerolamo Saccheri studies what geometry would be like if Euclid's fifth postulate were false,
• 1796 – Carl Friedrich Gauss proves that the regular 17-gon can be constructed using only a compass and straightedge
• 1797 – Caspar Wessel associates vectors with complex numbers and studies complex number operations in geometrical terms,
• 1799 – Gaspard Monge publishes Géométrie descriptive, in which he introduces descriptive geometry.

19th century

• 1806 – Louis Poinsot discovers the two remaining Kepler-Poinsot polyhedra.
• 1829 – Bolyai, Gauss, and Lobachevsky invent hyperbolic non-Euclidean geometry,
• 1837 – Pierre Wantzel proves that doubling the cube and trisecting the angle are impossible with only a compass and straightedge, as well as the full completion of the problem of constructibility of regular polygons
• 1843 – William Hamilton discovers the calculus of quaternions and deduces that they are non-commutative,
• 1854 – Bernhard Riemann introduces Riemannian geometry,
• 1854 – Arthur Cayley shows that quaternions can be used to represent rotations in four-dimensional space,
• 1858 – August Ferdinand Möbius invents the Möbius strip,
• 1870 – Felix Klein constructs an analytic geometry for Lobachevski’s geometry thereby establishing its self-consistency and the logical independence of Euclid’s fifth postulate,
• 1873 – Charles Hermite proves that e is transcendental,
• 1878 – Charles Hermite solves the general quintic equation by means of elliptic and modular functions
• 1882 – Ferdinand von Lindemann proves that π is transcendental and that therefore the circle cannot be squared with a compass and straightedge,
• 1882 – Felix Klein invents the Klein bottle,
• 1899 – David Hilbert presents a set of self-consistent geometric axioms in Foundations of Geometry

20th century

• 1901 – Élie Cartan develops the exterior derivative,
• 1912 – Luitzen Egbertus Jan Brouwer presents the Brouwer fixed-point theorem,
• 1916 – Einstein’s theory of general relativity.
• 1930 – Casimir Kuratowski shows that the three-cottage problem has no solution,
• 1931 – Georges de Rham develops theorems in cohomology and characteristic classes,
• 1933 – Karol Borsuk and Stanislaw Ulam present the Borsuk-Ulam antipodal-point theorem,
• 1955 – H. S. M. Coxeter et al. publish the complete list of uniform polyhedra,
• 1975 – Benoît Mandelbrot, fractals theory,
• 1981 – Mikhail Gromov develops the theory of hyperbolic groups, revolutionizing both infinite group theory and global differential geometry,
• 1983 – the classification of finite simple groups, a collaborative work involving some hundred mathematicians and spanning thirty years, is completed,
• 1991 – Alain Connes and John Lott develop non-commutative geometry,
• 1998 – Thomas Callister Hales proves the Kepler conjecture,

21st century

• 2003 – Grigori Perelman proves the Poincaré conjecture,
• 2007 – a team of researchers throughout North America and Europe used networks of computers to map E8 (mathematics).

Timeline of numerals and arithmetic

Before 2000 BC

• c. 20,000 BC — Nile Valley, Ishango Bone: suggested, though disputed, as the earliest reference to prime numbers as also a common number.
• c. 3400 BC — the Sumerians invent the first numeral system, and a system of weights and measures.
• c. 3100 BC — Egypt, earliest known decimal system allows indefinite counting by way of introducing new symbols, .
• c. 2800 BC — Indus Valley Civilization on the Indian subcontinent, earliest use of decimal ratios in a uniform system of ancient weights and measures, the smallest unit of measurement used is 1.704 millimetres and the smallest unit of mass used is 28 grams.
• c. 2000 BC — Mesopotamia, the Babylonians use a base-60 decimal system, and compute the first known approximate value of π at 3.125.

1st millennium BC

• c. 1000 BC — Vulgar fractions used by the Egyptians.
- second half of 1st millennium BC — The Lo Shu Square, the unique normal magic square of order three, was discovered in China.
- c. 400 BC — Jaina mathematicians in India write the “Surya Prajinapti”, a mathematical text which classifies all numbers into three sets: enumerable, innumerable and infinite. It also recognises five different types of infinity: infinite in one and two directions, infinite in area, infinite everywhere, and infinite perpetually.
- c. 300 BC — Brahmi numerals are conceived in India.
- 300 BC — Mesopotamia, the Babylonians invent the earliest calculator, the abacus.
- c. 300 BC — Indian mathematician Pingala writes the “Chhandah-sastra”, which contains the first Indian use of zero as a digit (indicated by a dot) and also presents a description of a binary numeral system, along with the first use of Fibonacci numbers and Pascal’s triangle.
- c. 250 BC — late Olmecs had already begun to use a true zero (a shell glyph) several centuries before Ptolemy in the New World. See 0 (number).
- 150 BC — Jain mathematicians in India write the “Sthananga Sutra”, which contains work on the theory of numbers, arithmetical operations, geometry, operations with fractions, simple equations, cubic equations, quartic equations, and permutations and combinations.
- 50 BC — Indian numerals, the first positional notation base-10 numeral system, begins developing in India.

1st millennium AD

- 300 — the earliest known use of zero as a decimal digit is introduced by Indian mathematicians.
- c. 400 — the Bakhshali manuscript is written by Jaina mathematicians, which describes a theory of the infinite containing different levels of infinity, shows an understanding of indices, as well as logarithms to base 2, and computes square roots of numbers as large as a million correct to at least 11 decimal places.
- 550 — Hindu mathematicians give zero a numeral representation in the positional notation Indian numeral system.
- 628 — Brahmagupta writes the *Brahma-sphuta-siddhanta*, where zero is clearly explained, and where the modern place-value Indian numeral system is fully developed. It also gives rules for manipulating both negative and positive numbers, methods for computing square roots, methods of solving linear and quadratic equations, and rules for summing series, Brahmagupta’s identity, and the Brahmagupta theorem.
- 940 — Abu’l-Wafa al-Buzjani extracts roots using the Indian numeral system.
- 953 — The arithmetic of the Hindu-Arabic numeral system at first required the use of a dust board (a sort of handheld blackboard) because “the methods required moving the numbers around in the calculation and
rubbing some out as the calculation proceeded.” Al-Uqlidisi modified these methods for pen and paper use. Eventually the advances enabled by the decimal system led to its standard use throughout the region and the world.

1000–1500

- c. 1000 — Pope Sylvester II introduces the abacus using the Hindu-Arabic numeral system to Europe.
- 1030 — Ali Ahmad Nasawi writes a treatise on the decimal and sexagesimal number systems. His arithmetic explains the division of fractions and the extraction of square and cubic roots (square root of 57,342; cubic root of 3, 652, 296) in an almost modern manner.
- 12th century — Indian numerals have been modified by Persian mathematicians al-Khwārizmī to form the modern Arabic numerals (used universally in the modern world.)
- 12th century — the Arabic numerals reach Europe through the Arabs.
- 1202 — Leonardo Fibonacci demonstrates the utility of Hindu-Arabic numeral system in his Book of the Abacus.
- c. 1400 — Ghiyath al-Kashi “contributed to the development of decimal fractions not only for approximating algebraic numbers, but also for real numbers such as pi. His contribution to decimal fractions is so major that for many years he was considered as their inventor. Although not the first to do so, al-Kashi gave an algorithm for calculating nth roots which is a special case of the methods given many centuries later by Ruffini and Horner.” He is also the first to use the decimal point notation in arithmetic and Arabic numerals. His works include The Key of arithmetics, Discoveries in mathematics, The Decimal point, and The benefits of the zero. The contents of the Benefits of the Zero are an introduction followed by five essays: “On whole number arithmetic”, “On fractional arithmetic”, “On astrology”, “On areas”, and “On finding the unknowns [unknown variables]”. He also wrote the Thesis on the sine and the chord and Thesis on finding the first degree sine.
- 1427 — Al-Kashi completes The Key to Arithmetic containing work of great depth on decimal fractions. It applies arithmetical and algebraic methods to the solution of various problems, including several geometric ones.
- 1478 — An anonymous author writes the Treviso Arithmetic.

17th century

- 1614 - John Napier discusses Napierian logarithms in Mirifici Logarithmorum Canonis Descriptio,
- 1617 - Henry Briggs discusses decimal logarithms in Logarithmorum Chilias Prima,
- 1618 - John Napier publishes the first references to $e$ in a work on logarithms.

**18th century**

- 1794 - Jurij Vega publishes *Thesaurus Logarithmorum Completus*.

**Calculation of Pi**

- 1706 - John Machin develops a quickly converging inverse-tangent series for $\pi$ and computes $\pi$ to 100 decimal places.
- 1789 - Jurij Vega improves Machin's formula and computes $\pi$ to 140 decimal places.
- 1949 - John von Neumann computes $\pi$ to 2,037 decimal places using ENIAC.
- 1961 - Daniel Shanks and John Wrench compute $\pi$ to 100,000 decimal places using an inverse-tangent identity and an IBM-7090 computer.
- 1987 - Yasumasa Kanada, David Bailey, Jonathan Borwein, and Peter Borwein use iterative modular equation approximations to elliptic integrals and a NEC SX-2 supercomputer to compute $\pi$ to 134 million decimal places.
- 2002 - Yasumasa Kanada, Y. Ushiro, Hisayasu Kuroda, Makoto Kudoh and a team of nine more compute $\pi$ to 1241.1 billion digits using a Hitachi 64-node supercomputer.

**Timeline of computational mathematics**

**1940s**

- Monte Carlo simulation (voted one of the top 10 algorithms of the 20th century) invented at Los Alamos by von Neumann, Ulam and Metropolis.
- Dantzig introduces the simplex algorithm (voted one of the top 10 algorithms of the 20th century).
- First hydro simulations at Los Alamos occurred.
- Ulam and von Neumann introduce the notion of cellular automata.
- A routine for the Manchester Baby written to factor a large number ($2^{18}$), one of the first in computational number theory. The Manchester group would make several other breakthroughs in this area.
- LU decomposition technique first discovered.
1950s

- Hestenes, Stiefel, and Lanczos, all from the Institute for Numerical Analysis at the National Bureau of Standards, initiate the development of Krylov subspace iteration methods. Voted one of the top 10 algorithms of the 20th century.
- *Equations of State Calculations by Fast Computing Machines* introduces the Metropolis–Hastings algorithm. Also, important earlier independent work by Alder and S. Frankel.
- In network theory, Ford & Fulkerson compute a solution to the maximum flow problem.
- Householder invents his eponymous matrices and transformation method (voted one of the top 10 algorithms of the 20th century).
- Molecular dynamics invented by Alder and Wainwright
- John G.F. Francis and Vera Kublanovskaya invent QR factorization (voted one of the top 10 algorithms of the 20th century).

1960s

- First recorded use of the term "finite element method" by Ray Clough, to describe the methods of Courant, Hrenikoff and Zienkiewicz, among others. See also here.
- Using computational investigations of the 3-body problem, Minovitch formulates the gravity assist method.
- Molecular dynamics was invented independently by Aneesur Rahman.
- Cooley and Tukey re-invent the Fast Fourier transform (voted one of the top 10 algorithms of the 20th century), an algorithm first discovered by Gauss.
- Edward Lorenz discovers the butterfly effect on a computer, attracting interest in chaos theory.
- Kruskal and Zabusky follow up the Fermi–Pasta–Ulam–Tsingou problem with further numerical experiments, and coin the term "soliton".
- Birch and Swinnerton-Dyer conjecture formulated through investigations on a computer.
- Grobner bases and Buchberger's algorithm invented for algebra
- Frenchman Verlet (re)discovers a numerical integration algorithm, (first used in 1791 by Delambre, by Cowell and Crommelin in 1909, and by Carl Fredrik Störmer in 1907, hence the alternative names Störmer's method or the Verlet-Störmer method) for dynamics.
- Risch invents algorithm for symbolic integration.
1970s

- Computer algebra replicates and extends the work of Delaunay in lunar theory.
- Mandelbrot, from studies of the Fatou, Julia and Mandelbrot sets, coined and popularized the term 'fractal' to describe these structures' self-similarity.
- Kenneth Appel and Wolfgang Haken prove the four colour theorem, the first theorem to be proved by computer.

1980s

- Fast multipole method invented by Rokhlin and Greengard (voted one of the top 10 algorithms of the 20th century).

1990s

- Kepler conjecture is almost all but certainly proved algorithmically by Thomas Hales in 1998.

2000s

- In computational group theory, God's number is shown to be 20.
- Mathematicians completely map the E8-group.

2010s

- Hales completes the proof of Kepler's conjecture.

Timeline of abelian varieties

Early history

- c. 1000 Al-Karaji writes on congruent numbers
Seventeenth century

- Fermat studies descent for elliptic curves
- 1643 Fermat poses an elliptic curve Diophantine equation
- 1670 Fermat's son published his *Diophantus* with notes

Eighteenth century

- 1718 Giulio Carlo Fagnano dei Toschi, studies the rectification of the lemniscate, addition results for elliptic integrals.
- 1736 Euler writes on the pendulum equation without the small-angle approximation.
- 1738 Euler writes on curves of genus 1 considered by Fermat and Frenicle
- 1750 Euler writes on elliptic integrals
- 23 December 1751-27 January 1752: Birth of the theory of elliptic functions, according to later remarks of Jacobi, as Euler writes on Fagnano's work.
- 1775 John Landen publishes Landen's transformation, an isogeny formula.
- 1786 Adrien-Marie Legendre begins to write on elliptic integrals
- 1797 C. F. Gauss discovers double periodicity of the lemniscate function
- 1799 Gauss finds the connection of the length of a lemniscate and a case of the arithmetic-geometric mean, giving a numerical method for a complete elliptic integral.

Nineteenth century

- 1826 Niels Henrik Abel, Abel-Jacobi map
- 1827 inversion of elliptic integrals independently by Abel and Carl Gustav Jacob Jacobi
- 1829 Jacobi, *Fundamenta nova theoriae functionum ellipticarum*, introduces four theta functions of one variable
- 1835 Jacobi points out the use of the group law for diophantine geometry, in *Du usu Theoriae Integralium Ellipticorum et Integralium Abelianorum in Analysi Diophantea*
- 1836-7 Friedrich Julius Richelot, the Richelot isogeny.
- 1847 Adolph Göpel gives the equation of the Kummer surface
- c. 1850 Thomas Weddle - Weddle surface
• 1856 Weierstrass elliptic functions

• 1857 Bernhard Riemann lays the foundations for further work on abelian varieties in dimension > 1, introducing the Riemann bilinear relations and Riemann theta function.

• 1865 Carl Johannes Thomae, *Theorie der ultraelliptischen Funktionen und Integrale erster und zweiter Ordnung*

• 1866, Alfred Clebsch and Paul Gordan, *Theorie der Abel'schen Functionen*

• 1869 Weierstrass proves an abelian function satisfies an algebraic addition theorem

• 1879, Charles Auguste Briot, *Théorie des fonctions abéliennes*

• 1880 In a letter to Richard Dedekind, Leopold Kronecker describes his *Jugendtraum*, to use complex multiplication theory to generate abelian extensions of imaginary quadratic fields

• 1884 Sofia Kovalevskaya writes on the reduction of abelian functions to elliptic functions

• 1888 Friedrich Schottky finds a non-trivial condition on the theta constants for curves of genus \(g = 4\), launching the Schottky problem.

• 1891 Appell–Humbert theorem of Paul Émile Appell and Georges Humbert, classifies the holomorphic line bundles on an abelian surface by cocycle data.

• 1894 *Die Entwicklung der Theorie der algebraischen Functionen in älterer und neuerer Zeit*, report by Alexander von Brill and Max Noether

• 1895 Wilhelm Wirtinger, *Untersuchungen über Thetafunktionen*, studies Prym varieties

• 1897 H. F. Baker, *Abelian Functions: Abel's Theorem and the Allied Theory of Theta Functions*

**Twentieth century**

• c.1910 The theory of Poincaré normal functions implies that the Picard variety and Albanese variety are isogenous.

• 1913 Torelli's theorem

• 1916 Gaetano Scorza applies the term "abelian variety" to complex tori.

• 1921 Lefschetz shows that any complex torus with Riemann matrix satisfying the necessary conditions can be embedded in some complex projective space using theta-functions

• 1922 Louis Mordell proves Mordell’s theorem: the rational points on an elliptic curve over the rational numbers form a finitely-generated abelian group

• 1929 Arthur B. Coble, *Algebraic Geometry and Theta Functions*

• 1939 Siegel modular forms

• c. 1940 Weil defines "abelian variety"
- 1952 André Weil defines an intermediate Jacobian
- Theorem of the cube
- Selmer group
- Michael Atiyah classifies holomorphic vector bundles on an elliptic curve
- 1961 Goro Shimura and Yutaka Taniyama, *Complex Multiplication of Abelian Varieties and its Applications to Number Theory*
- Néron model
- Birch–Swinnerton–Dyer conjecture
- Moduli space for abelian varieties
- Duality of abelian varieties
- c.1967 David Mumford develops a new theory of the equations defining abelian varieties
- 1968 Serre–Tate theorem on good reduction extends the results of Deuring on elliptic curves to the abelian variety case.
- 1983 Takahiro Shiota proves Novikov's conjecture on the Schottky problem
- 1985 Jean-Marc Fontaine shows that any positive-dimensional abelian variety over the rationals has bad reduction somewhere.

**Twenty-first century**

- 2001 Proof of the modularity theorem for elliptic curves is completed.

**Timeline of calculus and mathematical analysis**

**1000 to 1500**

- 1020 — Abul Wáfa — Discussed the quadrature of the parabola and the volume of the paraboloid.
- 1021 — Ibn al-Haytham completes his *Book of Optics*, which formulated and solved “Alhazen's problem” geometrically, and developed and proved the earliest general formula for infinitesimal and integral calculus using mathematical induction.
• 12th century — Bhāskara II conceives differential calculus, and also develops Rolle's theorem, Pell's equation, a proof for the Pythagorean Theorem, computes π to 5 decimal places, and calculates the time taken for the earth to orbit the sun to 9 decimal places

• 14th century — Madhava is considered the father of mathematical analysis, who also worked on the power series for pi and for sine and cosine functions, and along with other Kerala school mathematicians, founded the important concepts of Calculus

• 14th century — Parameshvara, a Kerala school mathematician, presents a series form of the sine function that is equivalent to its Taylor series expansion, states the mean value theorem of differential calculus, and is also the first mathematician to give the radius of circle with inscribed cyclic quadrilateral

• 1400 — Madhava discovers the series expansion for the inverse-tangent function, the infinite series for arctan and sin, and many methods for calculating the circumference of the circle, and uses them to compute π correct to 11 decimal places

16th century

• 1501 — Nilakantha Somayaji writes the “Tantra Samgraha”, which lays the foundation for a complete system of fluxions (derivatives), and expands on concepts from his previous text, the “Aryabhatiya Bhasya”.

• 1550 — Jyeshtadeva, a Kerala school mathematician, writes the “Yuktibhāṣā”, the world's first calculus text, which gives detailed derivations of many calculus theorems and formulae.

17th century

• 1629 - Pierre de Fermat develops a rudimentary differential calculus,

• 1634 - Gilles de Roberval shows that the area under a cycloid is three times the area of its generating circle,

• 1656 - John Wallis publishes *Arithmetica Infinitorum*,

• 1658 - Christopher Wren shows that the length of a cycloid is four times the diameter of its generating circle,

• 1665 - Isaac Newton works on the fundamental theorem of calculus and develops his version of infinitesimal calculus,

• 1671 - James Gregory develops a series expansion for the inverse-tangent function (originally discovered by Madhava),

• 1673 - Gottfried Leibniz also develops his version of infinitesimal calculus,

• 1675 - Isaac Newton invents a Newton's method for the computation of functional roots,
• 1691 - Gottfried Leibniz discovers the technique of separation of variables for ordinary differential equations,
• 1696 - Guillaume de L'Hôpital states his rule for the computation of certain limits,
• 1696 - Jakob Bernoulli and Johann Bernoulli solve brachistochrone problem, the first result in the calculus of variations.

18th century

• 1712 - Brook Taylor develops Taylor series,
• 1730 - James Stirling publishes *The Differential Method*,
• 1734 - Leonhard Euler introduces the integrating factor technique for solving first-order ordinary differential equations,
• 1735 - Leonhard Euler solves the Basel problem, relating an infinite series to π,
• 1739 - Leonhard Euler solves the general homogeneous linear ordinary differential equation with constant coefficients,
• 1748 - Maria Gaetana Agnesi discusses analysis in *Instituzioni Analitiche ad Uso della Gioventu Italiana*,
• 1762 - Joseph Louis Lagrange discovers the divergence theorem,

19th century

• 1807 - Joseph Fourier announces his discoveries about the trigonometric decomposition of functions,
• 1811 - Carl Friedrich Gauss discusses the meaning of integrals with complex limits and briefly examines the dependence of such integrals on the chosen path of integration,
• 1815 - Siméon Denis Poisson carries out integrations along paths in the complex plane,
• 1817 - Bernard Bolzano presents the intermediate value theorem—a continuous function which is negative at one point and positive at another point must be zero for at least one point in between,
• 1822 - Augustin-Louis Cauchy presents the Cauchy integral theorem for integration around the boundary of a rectangle in the complex plane,
• 1825 - Augustin-Louis Cauchy presents the Cauchy integral theorem for general integration paths—he assumes the function being integrated has a continuous derivative, and he introduces the theory of residues in complex analysis,
• 1825 - André-Marie Ampère discovers Stokes' theorem,
• 1828 - George Green introduces Green's theorem,
• 1831 - Mikhail Vasilievich Ostrogradsky rediscovers and gives the first proof of the divergence theorem earlier described by Lagrange, Gauss and Green,

• 1841 - Karl Weierstrass discovers but does not publish the Laurent expansion theorem,

• 1843 - Pierre-Alphonse Laurent discovers and presents the Laurent expansion theorem,

• 1850 - Victor Alexandre Puiseux distinguishes between poles and branch points and introduces the concept of essential singular points,

• 1850 - George Gabriel Stokes rediscovers and proves Stokes' theorem,

• 1873 - Georg Frobenius presents his method for finding series solutions to linear differential equations with regular singular points,

20th century

• 1908 - Josip Plemelj solves the Riemann problem about the existence of a differential equation with a given monodromic group and uses Sokhotsky - Plemelj formulae,

• 1966 - Abraham Robinson presents Non-standard analysis.

• 1985 - Louis de Branges de Bourcia proves the Bieberbach conjecture,

Timeline of number theory

Before 1000 BC

• ca. 20,000 BC — Nile Valley, Ishango Bone: possibly the earliest reference to prime numbers and Egyptian multiplication although this is disputed.

About 300 BC

• 300 BC — Euclid proves the number of prime numbers is infinite.

1st millennium AD

• 250 — Diophantus writes Arithmetica, one of the earliest treatises on algebra.

• 500 — Aryabhata solves the general linear diophantine equation.
• ca. 650 — Mathematicians in India create the Hindu-Arabic numeral system we use, including the zero, the decimals and negative numbers.

1000–1500

• ca. 1000 — Abu-Mahmud al-Khujandi first states a special case of Fermat's Last Theorem.
• 895 — Thabit ibn Qurra gives a theorem by which pairs of amicable numbers can be found, (i.e., two numbers such that each is the sum of the proper divisors of the other).
• 975 — The earliest triangle of binomial coefficients (Pascal triangle) occur in the 10th century in commentaries on the Chandas Shasta.
• 1150 — Bhaskara II gives first general method for solving Pell's equation.
• 1260 — Al-Farisi gave a new proof of Thābit ibn Qurra's theorem, introducing important new ideas concerning factorization and combinatorial methods. He also gave the pair of amicable numbers 17296 and 18416 which have also been jointly attributed to Fermat as well as Thabit ibn Qurra.

17th century

• 1637 - Pierre de Fermat claims to have proven Fermat's Last Theorem in his copy of Diophantus' *Arithmetica*.

18th century

• 1742 - Christian Goldbach conjectures that every even number greater than two can be expressed as the sum of two primes, now known as Goldbach's conjecture.
• 1770 - Joseph Louis Lagrange proves the four-square theorem, that every positive integer is the sum of four squares of integers. In the same year, Edward Waring conjectures Waring's problem, that for any positive integer $k$, every positive integer is the sum of a fixed number of $k$th powers.
• 1796 - Adrien-Marie Legendre conjectures the prime number theorem.

19th century

• 1801 - *Disquisitiones Arithmeticae*, Carl Friedrich Gauss's number theory treatise, is published in Latin.
• 1825 - Peter Gustav Lejeune Dirichlet and Adrien-Marie Legendre prove Fermat's Last Theorem for $n = 5$.
• 1832 - Lejeune Dirichlet proves Fermat's Last Theorem for $n = 14$.
• 1835 - Lejeune Dirichlet proves Dirichlet's theorem about prime numbers in arithmetical progressions.
• 1859 - Bernhard Riemann formulates the Riemann hypothesis which has strong implications about the distribution of prime numbers.

• 1896 - Jacques Hadamard and Charles Jean de la Vallée-Poussin independently prove the prime number theorem.

• 1896 - Hermann Minkowski presents *Geometry of numbers*.

20th century

• 1903 - Edmund Georg Hermann Landau gives considerably simpler proof of the prime number theorem.

• 1909 - David Hilbert proves Waring's problem.

• 1912 - Josip Plemelj publishes simplified proof for the Fermat's Last Theorem for exponent $n = 5$.

• 1913 - Srinivasa Aiyangar Ramanujan sends a long list of complex theorems without proofs to G. H. Hardy.

• 1914 - Srinivasa Aiyangar Ramanujan publishes *Modular Equations and Approximations to π*.

• 1910s - Srinivasa Aiyangar Ramanujan develops over 3000 theorems, including properties of highly composite numbers, the partition function and its asymptotics, and mock theta functions. He also makes major breakthroughs and discoveries in the areas of gamma functions, modular forms, divergent series, hypergeometric series and prime number theory.

• 1919 - Viggo Brun defines Brun's constant $B_2$ for twin primes.

• 1937 - I. M. Vinogradov proves Vinogradov's theorem that every sufficiently large odd integer is the sum of three primes, a close approach to proving Goldbach's weak conjecture.

• 1949 - Atle Selberg and Paul Erdős give the first elementary proof of the prime number theorem.

• 1966 - Chen Jingrun proves Chen's theorem, a close approach to proving the Goldbach conjecture.

• 1967 - Robert Langlands formulates the influential Langlands program of conjectures relating number theory and representation theory.

• 1983 - Gerd Faltings proves the Mordell conjecture and thereby shows that there are only finitely many whole number solutions for each exponent of Fermat's Last Theorem.

• 1994 - Andrew Wiles proves part of the Taniyama–Shimura conjecture and thereby proves Fermat's Last Theorem.

• 1999 - the full Taniyama–Shimura conjecture is proved.
21st century

- 2002 - Manindra Agrawal, Nitin Saxena, and Neeraj Kayal of IIT Kanpur present an unconditional
deterministic polynomial time algorithm to determine whether a given number is prime.
- 2002 - Preda Mihăilescu proves Catalan's conjecture.
- 2004 - Ben Green and Terence Tao prove the Green–Tao theorem, which states that the sequence of prime
numbers contains arbitrarily long arithmetic progressions.

Timeline of mathematical logic

19th century

- 1847 – George Boole proposes symbolic logic in The Mathematical Analysis of Logic, defining what is
now called Boolean algebra.
- 1854 – George Boole perfects his ideas, with the publication of An Investigation of the Laws of Thought.
- 1874 – Georg Cantor proves that the set of all real numbers is uncountably infinite but the set of all
real algebraic numbers is countably infinite. His proof does not use his famous diagonal argument, which
he published in 1891.
- 1895 – Georg Cantor publishes a book about set theory containing the arithmetic of infinite cardinal
numbers and the continuum hypothesis.
- 1899 – Georg Cantor discovers a contradiction in his set theory.

20th century

- 1908 – Ernst Zermelo axiomatizes set theory, thus avoiding Cantor's contradictions.
- 1931 – Kurt Gödel proves his incompleteness theorem which shows that every axiomatic system for
mathematics is either incomplete or inconsistent.
- 1940 – Kurt Gödel shows that neither the continuum hypothesis nor the axiom of choice can be disproven
from the standard axioms of set theory.
- 1961 – Abraham Robinson creates non-standard analysis.
- 1963 – Paul Cohen uses his technique of forcing to show that neither the continuum hypothesis nor
the axiom of choice can be proven from the standard axioms of set theory.
**Timeline of the evolutionary history of life**

- In this timeline, Ma (for *megaannum*) means "million years ago," ka (for *kiloannum*) means "thousand years ago," and ya means "years ago."

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>4600 Ma</td>
<td>The planet Earth forms from the accretion disc revolving around the young Sun, with organic compounds (complex organic molecules) necessary for life having perhaps formed in the protoplanetary disk of cosmic dust grains surrounding it before the formation of the Earth itself.</td>
</tr>
<tr>
<td>4500 Ma</td>
<td>According to the giant impact hypothesis, the Moon originated when the planet Earth and the hypothesized planet Theia collided, sending a very large number of moonlets into orbit around the young Earth which eventually coalesced to form the Moon. The gravitational pull of the new Moon stabilised the Earth's fluctuating axis of rotation and set up the conditions in which abiogenesis could occur.</td>
</tr>
<tr>
<td>4400 Ma</td>
<td>First appearance of liquid water on Earth.</td>
</tr>
<tr>
<td>4280 Ma</td>
<td>Earliest possible appearance of life on Earth.</td>
</tr>
</tbody>
</table>

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<tr>
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<tr>
<td>4000 Ma</td>
<td>Formation of a greenstone belt of the Acasta Gneiss of the Slave craton in Northwest Territories, Canada, the oldest rock belt in the world.</td>
</tr>
<tr>
<td>4100–3800 Ma</td>
<td>Late Heavy Bombardment (LHB): extended barrage of impact events upon the inner planets by meteoroids. Thermal flux from widespread hydrothermal activity during the LHB may have been conducive to abiogenesis and life's early diversification. &quot;Remains of biotic life&quot; were found in 4.1 billion-year-old rocks in Western Australia. This is when life most likely arose.</td>
</tr>
<tr>
<td>3900–2500 Ma</td>
<td>Cells resembling prokaryotes appear. These first organisms are chemoautotrophs: they use carbon dioxide as a carbon source and oxidize inorganic materials to extract energy. Later, prokaryotes evolve glycolysis, a set of chemical reactions that free the energy of organic molecules such as glucose and store it in the chemical bonds of ATP. Glycolysis (and ATP) continue to be used in almost all organisms, unchanged, to this day.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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<tr>
<td>3800 Ma</td>
<td>Formation of a greenstone belt of the Isua complex of the western Greenland region, whose rocks show an isotope frequency suggestive of the presence of life. The earliest evidences for life on Earth are 3.8 billion-year-old biogenic hematite in a banded iron formation of the Nuvvuagittuq Greenstone Belt in Canada, graphite in 3.7 billion-year-old metasedimentary rocks discovered in western Greenland and microbial mat fossils found in 3.48 billion-year-old sandstone discovered in Western Australia.</td>
</tr>
<tr>
<td>3500 Ma</td>
<td>Lifetime of the last universal common ancestor (LUCA); the split between bacteria and archaea occurs. Bacteria develop primitive forms of photosynthesis which at first did not produce oxygen. These organisms generated Adenosine triphosphate (ATP) by exploiting a proton gradient, a mechanism still used in virtually all organisms.</td>
</tr>
<tr>
<td>3200 Ma</td>
<td>Diversification and expansion of acritarchs.</td>
</tr>
<tr>
<td>3000 Ma</td>
<td>Photosynthesizing cyanobacteria evolved; they used water as a reducing agent, thereby producing oxygen as a waste product.</td>
</tr>
<tr>
<td>2800 Ma</td>
<td>Oldest evidence for microbial life on land in the form of organic matter-rich paleosols, ephemeral ponds and alluvial sequences, some of them bearing microfossils.</td>
</tr>
<tr>
<td>2500 Ma</td>
<td>Great Oxidation Event led by cyanobacteria's oxygenic photosynthesis. Commencement of plate tectonics with old marine crust dense enough to subduct.</td>
</tr>
<tr>
<td>By 1850 Ma</td>
<td>Eukaryotic cells appear. Eukaryotes contain membrane-bound organelles with diverse functions, probably derived from prokaryotes engulffing each other via phagocytosis. (See Symbiogenesis and Endosymbiont). Bacterial viruses (bacteriophage) emerge before, or soon after, the divergence of the prokaryotic and eukaryotic lineages. The appearance of red beds show that an oxidising atmosphere had been produced. Incentives now favoured the spread of eukaryotic life.</td>
</tr>
<tr>
<td>1400 Ma</td>
<td>Great increase in stromatolite diversity.</td>
</tr>
<tr>
<td>1300 Ma</td>
<td>Earliest land fungi</td>
</tr>
</tbody>
</table>
By 1200 Ma  Meiosis and sexual reproduction are present in single-celled eukaryotes, and possibly in the common ancestor of all eukaryotes. Sex may even have arisen earlier in the RNA world. Sexual reproduction first appears in the fossil records; it may have increased the rate of evolution.

1000 Ma  The first non-marine eukaryotes move onto land. They were photosynthetic and multicellular, indicating that plants evolved much earlier than originally thought.

750 Ma  First protozoa (ex: *Melanocyrillium*); beginning of animal evolution

850–630 Ma  A global glaciation may have occurred. Opinion is divided on whether it increased or decreased biodiversity or the rate of evolution. It is believed that this was due to evolution of the first land plants, which increased the amount of oxygen and lowered the amount of carbon dioxide in the atmosphere.

600 Ma  The accumulation of atmospheric oxygen allows the formation of an ozone layer. Prior to this, land-based life would probably have required other chemicals to attenuate ultraviolet radiation enough to permit colonisation of the land.

580–542 Ma  The Ediacara biota represent the first large, complex aquatic multicellular organisms — although their affinities remain a subject of debate.

580–500 Ma  Most modern phyla of animals begin to appear in the fossil record during the Cambrian explosion.

550 Ma  First fossil evidence for Ctenophora (comb jellies), Porifera (sponges), Anthozoa (corals and sea anemones). Appearance of Ikaria wariootia (an early Bilaterian).

<table>
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<tr>
<td>535 Ma</td>
<td>Major diversification of living things in the oceans: chordates, arthropods (e.g. trilobites, crustaceans), echinoderms, molluscs, brachiopods, foraminifers and radiolarians, etc.</td>
</tr>
<tr>
<td>530 Ma</td>
<td>The first known footprints on land date to 530 Ma.</td>
</tr>
<tr>
<td>525 Ma</td>
<td>Earliest graptolites</td>
</tr>
<tr>
<td>511 Ma</td>
<td>Earliest crustaceans</td>
</tr>
<tr>
<td>510 Ma</td>
<td>First cephalopods (nautiloids) and chitons</td>
</tr>
<tr>
<td>505 Ma</td>
<td>Fossilization of the Burgess Shale</td>
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<tr>
<td>500 Ma</td>
<td>Jellyfish have existed since at least this time.</td>
</tr>
<tr>
<td>485 Ma</td>
<td>First vertebrates with true bones (jawless fishes)</td>
</tr>
<tr>
<td>450 Ma</td>
<td>First complete conodonts and echinoids appear</td>
</tr>
<tr>
<td>440 Ma</td>
<td>First agnathan fishes: Heterostraci, Galeaspida, and Pituriaspida</td>
</tr>
<tr>
<td>420 Ma</td>
<td>Earliest ray-finned fishes, trigonotarbid arachnids, and land scorpions</td>
</tr>
<tr>
<td>410 Ma</td>
<td>First signs of teeth in fish. Earliest Nautilida, lycophytes, and trimerophytes.</td>
</tr>
<tr>
<td>395 Ma</td>
<td>First lichens, stoneworts. Earliest harvestmen, mites, hexapods (springtails) and ammonoids. The first known tetrapod tracks on land.</td>
</tr>
<tr>
<td>365 Ma</td>
<td><em>Acanthostega</em> is one of the earliest vertebrates capable of walking.</td>
</tr>
<tr>
<td>363 Ma</td>
<td>By the start of the Carboniferous Period, the Earth begins to resemble its present state. Insects roamed the land and would soon take to the skies; sharks swam the oceans as top predators, and vegetation covered the land, with seed-bearing plants and forests soon to flourish. Four-limbed tetrapods gradually gain adaptations which will help them occupy a terrestrial life-habit.</td>
</tr>
<tr>
<td>360 Ma</td>
<td>First crabs and ferns. Land flora dominated by seed ferns. The Xinhang forest grows around this time</td>
</tr>
<tr>
<td>350 Ma</td>
<td>First large sharks, ratfishes, and hagfish</td>
</tr>
<tr>
<td>340 Ma</td>
<td>Diversification of amphibians</td>
</tr>
<tr>
<td>330 Ma</td>
<td>First amniote vertebrates (<em>Paleothyris</em>)</td>
</tr>
<tr>
<td>320 Ma</td>
<td>Synapsids (precursors to mammals) separate from sauropsids (reptiles) in late Carboniferous.</td>
</tr>
<tr>
<td>305 Ma</td>
<td>Earliest diapsid reptiles (e.g. <em>Petrolacosaurus</em>)</td>
</tr>
<tr>
<td>296 Ma</td>
<td>Earliest known octopus (<em>Pohlseopia</em>)</td>
</tr>
<tr>
<td>280 Ma</td>
<td>Earliest beetles, seed plants and conifers diversify while lepidodendrds and sphenopsids decrease. Terrestrial temnospondyl amphibians and pelycosaurs (e.g. <em>Dimetrodon</em>) diversify in species.</td>
</tr>
<tr>
<td>275 Ma</td>
<td>Therapsid synapsids separate from pelycosaur synapsids</td>
</tr>
<tr>
<td>270 Ma</td>
<td>Gorgonopsians appear in the fossil record</td>
</tr>
</tbody>
</table>
The Permian–Triassic extinction event eliminates over 90-95% of marine species. Terrestrial organisms were not as seriously affected as the marine biota. This "clearing of the slate" may have led to an ensuing diversification, but life on land took 30 million years to completely recover.

<table>
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<tr>
<td>250 Ma</td>
<td>The Mesozoic Marine Revolution begins: increasingly well adapted and diverse predators pressurize sessile marine groups; the &quot;balance of power&quot; in the oceans shifts dramatically as some groups of prey adapt more rapidly and effectively than others.</td>
</tr>
<tr>
<td>250 Ma</td>
<td><em>Triadobatrachus massinoti</em> is the earliest known frog</td>
</tr>
<tr>
<td>248 Ma</td>
<td>Sturgeon and paddlefish (<em>Acipenseridae</em>) first appear.</td>
</tr>
<tr>
<td>245 Ma</td>
<td>Earliest ichthyosaurs</td>
</tr>
<tr>
<td>240 Ma</td>
<td>Increase in diversity of gomphodont cynodonts and rynchosaurus</td>
</tr>
<tr>
<td>225 Ma</td>
<td>Earliest dinosaurs (prosauropods), first cardiid bivalves, diversity in cycads, bennettitaleans, and conifers. First teleost fishes. First mammals (<em>Adelobasileus</em>).</td>
</tr>
<tr>
<td>220 Ma</td>
<td>Seed-producing Gymnosperm forests dominate the land; herbivores grow to huge sizes to accommodate the large guts necessary to digest the nutrient-poor plants. First flies and turtles (<em>Odontochelys</em>). First coelophysoid dinosaurs.</td>
</tr>
<tr>
<td>205 Ma</td>
<td>The Massive extinction of Triassic/Jurassic, that wiped out most of the group of pseudosuchians and gave the opportunity of dinosaurs including the Apatosaurus, Tyrannosaurus, Perrotasaurus, and Stegosaurus to enter their golden age.</td>
</tr>
<tr>
<td>200 Ma</td>
<td>The first accepted evidence for viruses that infect eukaryotic cells (at least, the group Geminiviridae) existed. Viruses are still poorly understood and may have arisen before &quot;life&quot; itself, or may be a more recent phenomenon. Major extinctions in terrestrial vertebrates and large amphibians. Earliest examples of armoured dinosaurs</td>
</tr>
<tr>
<td>195 Ma</td>
<td>First pterosaurs with specialized feeding (<em>Dorygnathus</em>). First sauropod dinosaurs. Diversification in small, ornithischian dinosaurs: heterodontosaurids, fabrosaurids, and scelidosaurids.</td>
</tr>
<tr>
<td>190 Ma</td>
<td>Pliosaurids appear in the fossil record. First lepidopteran insects (<em>Archaeolepis</em>), hermit crabs, modern starfish, irregular echinoids, corbulid bivalves, and tubulipore bryozoans. Extensive development of sponge reefs.</td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
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</tr>
<tr>
<td>176 Ma</td>
<td>First members of the Stegosauria group of dinosaurs</td>
</tr>
<tr>
<td>170 Ma</td>
<td>Earliest salamanders, newts, cryptodids, elasmosaurid plesiosaurs, and cladotherian mammals. Sauropod dinosaurs diversify.</td>
</tr>
<tr>
<td>165 Ma</td>
<td>First rays and glycymerid bivalves. First vampire squids</td>
</tr>
<tr>
<td>163 Ma</td>
<td>Pterodactyloid pterosaurs first appear</td>
</tr>
<tr>
<td>161 Ma</td>
<td>Ceratopsian dinosaurs appear in the fossil record (Yinlong) and the oldest known Eutherian Mammal appear in the fossil record: Juramaia.</td>
</tr>
<tr>
<td>160 Ma</td>
<td>Multituberculate mammals (genus Rugosodon) appear in eastern China</td>
</tr>
<tr>
<td>155 Ma</td>
<td>First blood-sucking insects (ceratopogonids), rudist bivalves, and cheilostome bryozoans. Archaeopteryx, a possible ancestor to the birds, appears in the fossil record, along with triconodontid and symmetrodont mammals. Diversity in stegosaurian and theropod dinosaurs.</td>
</tr>
<tr>
<td>153 Ma</td>
<td>First pine trees</td>
</tr>
<tr>
<td>140 Ma</td>
<td>Orb-weaver spiders appear</td>
</tr>
<tr>
<td>130 Ma</td>
<td>The rise of the angiosperms: Some of these flowering plants bear structures that attract insects and other animals to spread pollen; other angiosperms were pollinated by wind or water. This innovation causes a major burst of animal evolution through coevolution. First freshwater pelomedusid turtles. Earliest krill.</td>
</tr>
<tr>
<td>120 Ma</td>
<td>Oldest fossils of heterokonts, including both marine diatoms and silicoflagellates</td>
</tr>
<tr>
<td>115 Ma</td>
<td>First monotreme mammals</td>
</tr>
<tr>
<td>112 Ma</td>
<td>Xiphactinus, a large predatory fish, appears in the fossil record</td>
</tr>
<tr>
<td>110 Ma</td>
<td>First hesperornithes, toothed diving birds. Earliest limopsid, verticordiid, and thyasirid bivalves.</td>
</tr>
<tr>
<td>106 Ma</td>
<td>Spinosaurus, the largest theropod dinosaur, appears in the fossil record</td>
</tr>
<tr>
<td>100 Ma</td>
<td>Earliest bees</td>
</tr>
<tr>
<td>95 Ma</td>
<td>First crocodilians evolve</td>
</tr>
<tr>
<td>80 Ma</td>
<td>First ants</td>
</tr>
<tr>
<td>70 Ma</td>
<td>Multituberculate mammals increase in diversity. First yoldiid bivalves.</td>
</tr>
<tr>
<td>68 Ma</td>
<td>Tyrannosaurs, the largest terrestrial predator of what is now western North America appears in the fossil record. First species of Triceratops.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>66 Ma</td>
<td>The Cretaceous–Paleogene extinction event eradicates about half of all animal species, including mosasaurs, pterosaurs, plesiosaurs, ammonites, belemnites, rudist and inoceramid bivalves, most planktic foraminifers, and all of the dinosaurs excluding the birds.</td>
</tr>
<tr>
<td>66 Ma</td>
<td>Rapid dominance of conifers and ginkgos in high latitudes, along with mammals becoming the dominant species. First psammobiid bivalves. Earliest rodents. Rapid diversification in ants.</td>
</tr>
<tr>
<td>63 Ma</td>
<td>Evolution of the creodonts, an important group of meat-eating (carnivorous) mammals</td>
</tr>
<tr>
<td>62 Ma</td>
<td>Evolution of the first penguins</td>
</tr>
<tr>
<td>60 Ma</td>
<td>Diversification of large, flightless birds. Earliest true primates,</td>
</tr>
<tr>
<td>59 Ma</td>
<td>Earliest sailfish appear</td>
</tr>
<tr>
<td>56 Ma</td>
<td><em>Gastornis</em>, a large flightless bird, appears in the fossil record</td>
</tr>
<tr>
<td>55 Ma</td>
<td>Modern bird groups diversify (first song birds, parrots, loons, swifts, woodpeckers), first whale (<em>Himalayacetus</em>), earliest lagomorphs, armadillos, appearance of sirenian, proboscidean, perissodactyl and artiodactyl mammals in the fossil record. Angiosperms diversify. The ancestor (according to theory) of the species in the genus <em>Carcharodon</em>, the early mako shark <em>Isurus hastalis</em>, is alive.</td>
</tr>
<tr>
<td>52 Ma</td>
<td>First bats appear (<em>Onychonycteris</em>)</td>
</tr>
<tr>
<td>50 Ma</td>
<td>Peak diversity of dinoflagellates and nannofossils, increase in diversity of anomalodesmatan and heteroconch bivalves, brontotheres, tapirs, rhinoceroses, and camels appear in the fossil record, diversification of primates</td>
</tr>
<tr>
<td>40 Ma</td>
<td>Modern-type butterflies and moths appear. Extinction of <em>Gastornis. Basilosaurus</em>, one of the first of the giant whales, appeared in the fossil record.</td>
</tr>
<tr>
<td>38 Ma</td>
<td>Earliest bears</td>
</tr>
<tr>
<td>37 Ma</td>
<td>First nimravid (&quot;false saber-toothed cats&quot;) carnivores — these species are unrelated to modern-type felines. First alligators</td>
</tr>
<tr>
<td>Time</td>
<td>Event</td>
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<td>-------</td>
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</tr>
<tr>
<td>35 Ma</td>
<td>Grasses diversify from among the monocot angiosperms; grasslands begin to expand. Slight increase in diversity of cold-tolerant ostracods and foraminifers, along with major extinctions of gastropods, reptiles, amphibians, and multituberculate mammals. Many modern mammal groups begin to appear: first glyptodonts, ground sloths, canids, peccaries, and the first eagles and hawks. Diversity in toothed and baleen whales.</td>
</tr>
<tr>
<td>33 Ma</td>
<td>Evolution of the thylacinid marsupials (<em>Badjcinus</em>)</td>
</tr>
<tr>
<td>30 Ma</td>
<td>First balanids and eucalypts, extinction of embrithopod and brontotherian mammals, earliest pigs and cats</td>
</tr>
<tr>
<td>28 Ma</td>
<td><em>Paraceratherium</em> appears in the fossil record, the largest terrestrial mammal that ever lived. First pelicans.</td>
</tr>
<tr>
<td>25 Ma</td>
<td><em>Pelagornis sandersi</em> appears in the fossil record, the largest flying bird that ever lived</td>
</tr>
<tr>
<td>25 Ma</td>
<td>First deer</td>
</tr>
<tr>
<td>24 Ma</td>
<td>First pinnipeds</td>
</tr>
<tr>
<td>23 Ma</td>
<td>Earliest ostriches, trees representative of most major groups of oaks have appeared by now</td>
</tr>
<tr>
<td>20 Ma</td>
<td>First giraffes, hyenas, and giant anteaters, increase in bird diversity</td>
</tr>
<tr>
<td>17 Ma</td>
<td>First birds of the genus <em>Corvus</em> (crows)</td>
</tr>
<tr>
<td>15 Ma</td>
<td>Genus <em>Mammut</em> appears in the fossil record, first bovids and kangaroos, diversity in Australian megafauna</td>
</tr>
<tr>
<td>10 Ma</td>
<td>Grasslands and savannas are established, diversity in insects, especially ants and termites, horses increase in body size and develop high-crowned teeth, major diversification in grassland mammals and snakes</td>
</tr>
<tr>
<td>9.5 Ma</td>
<td>The Great American Interchange, where various land and freshwater faunas migrated between North and South America. Armadillos, opossums, hummingbirds Phorusrhacids, Ground Sloths, Glyptodonts, and Meridiungulates traveled to North America, while horses, tapirs, saber-toothed cats, Jaguars, Bears, Coatis, Ferrets, Otters, Skunks and deer entered South America.</td>
</tr>
<tr>
<td>9 Ma</td>
<td>First platypuses</td>
</tr>
<tr>
<td>6.5 Ma</td>
<td>First hominins (<em>Sahelanthropus</em>)</td>
</tr>
<tr>
<td>6 Ma</td>
<td>Australopithecines diversify (<em>Orrorin, Ardipithecus</em>)</td>
</tr>
<tr>
<td>5 Ma</td>
<td>First tree sloths and hippopotami, diversification of grazing herbivores like zebras and elephants, large</td>
</tr>
</tbody>
</table>
carnivorous mammals like lions and the genus *Canis*, burrowing rodents, kangaroos, birds, and small carnivores, vultures increase in size, decrease in the number of perissodactyl mammals. Extinction of nimbread carnivores. First leopard seals.

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.8 Ma</td>
<td>Mammoths appear in the fossil record</td>
</tr>
<tr>
<td>4.5 Ma</td>
<td>Marine iguanas diverge from land iguanas</td>
</tr>
<tr>
<td>4 Ma</td>
<td>Evolution of <em>Australopithecus, Stupendemys</em> appears in the fossil record as the largest freshwater turtle, first modern elephants, giraffes, zebras, lions, rhinoceros and gazelles appear in the fossil record</td>
</tr>
<tr>
<td>3.6 Ma</td>
<td>Blue whales grow to their modern sizes</td>
</tr>
<tr>
<td>3 Ma</td>
<td>Earliest swordfish</td>
</tr>
<tr>
<td>2.7 Ma</td>
<td>Evolution of <em>Paranthropus</em></td>
</tr>
<tr>
<td>2.5 Ma</td>
<td>The earliest species of <em>Smilodon</em> evolve</td>
</tr>
<tr>
<td>2 Ma</td>
<td>First members of the genus <em>Homo, Homo Habilis</em>, appear in the fossil record. Diversification of conifers in high latitudes. The eventual ancestor of cattle, aurochs (<em>Bos primigenus</em>), evolves in India.</td>
</tr>
<tr>
<td>1.7 Ma</td>
<td>Extinction of australopithecines</td>
</tr>
<tr>
<td>1.2 Ma</td>
<td>Evolution of <em>Homo antecessor</em>. The last members of <em>Paranthropus</em> die out.</td>
</tr>
<tr>
<td>1 Ma</td>
<td>First coyotes</td>
</tr>
<tr>
<td>800 Ka</td>
<td>Short-faced bears (<em>Arctodus simus</em>) become abundant in North America</td>
</tr>
<tr>
<td>600 ka</td>
<td>Evolution of <em>Homo heidelbergensis</em></td>
</tr>
<tr>
<td>400 ka</td>
<td>First polar bears</td>
</tr>
<tr>
<td>350 ka</td>
<td>Evolution of Neanderthals</td>
</tr>
<tr>
<td>300 ka</td>
<td><em>Gigantopithecus</em>, a giant relative of the orangutan from Asia dies out</td>
</tr>
<tr>
<td>250 ka</td>
<td>Anatomically modern humans appear in Africa. Around 50,000 years before present they start colonising the other continents, replacing the Neanderthals in Europe and other hominins in Asia.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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<tr>
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<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>40 ka</td>
<td>The last of the giant monitor lizards (Varanus priscus) die out</td>
</tr>
<tr>
<td>30 ka</td>
<td>Extinction of Neanderthals, first domestic dogs</td>
</tr>
<tr>
<td>15 ka</td>
<td>The last woolly rhinoceros (<em>Coelodonta antiquitatis</em>) are believed to have gone extinct</td>
</tr>
<tr>
<td>11 ka</td>
<td>Short-faced bears vanish from North America, with the last giant ground sloths dying out. All Equidae become extinct in North America.</td>
</tr>
<tr>
<td>10 ka</td>
<td>The Holocene epoch starts 10,000 years ago after the Late Glacial Maximum. The last mainland species of woolly mammoth (<em>Mammuthus primigenus</em>) die out, as does the last <em>Smilodon</em> species.</td>
</tr>
<tr>
<td>8 ka</td>
<td>The Giant Lemur died out</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>6000 ya (c. 4000 BC)</td>
<td>Small populations of American mastodon die off in places like Utah and Michigan</td>
</tr>
<tr>
<td>4500 ya (c. 2500 BC)</td>
<td>The last members of a dwarf race of woolly mammoths vanish from Wrangel Island near Alaska</td>
</tr>
<tr>
<td>c. 600 ya (c. 1400)</td>
<td>The moa and its predator, Haast's eagle, die out in New Zealand</td>
</tr>
<tr>
<td>393 ya (1627)</td>
<td>The last recorded wild aurochs die out</td>
</tr>
<tr>
<td>332 ya (1688)</td>
<td>The dodo goes extinct</td>
</tr>
<tr>
<td>252 ya (1768)</td>
<td>The Steller's sea cow goes extinct</td>
</tr>
<tr>
<td>137 ya (1883)</td>
<td>The quagga, a subspecies of zebra, goes extinct</td>
</tr>
<tr>
<td>114 ya (1905)</td>
<td>Wolves become extinct in Japan.</td>
</tr>
<tr>
<td>106 ya (1914)</td>
<td>Martha, last known passenger pigeon, dies</td>
</tr>
<tr>
<td>84 ya (1936)</td>
<td>The thylacine goes extinct in a Tasmanian zoo, the last member of the family Thylacinidae</td>
</tr>
<tr>
<td>82 ya (1937)</td>
<td>The last Bali tiger was shot.</td>
</tr>
<tr>
<td>68 ya (1952)</td>
<td>The Caribbean monk seal goes extinct</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
</tr>
<tr>
<td>------</td>
<td>------------------------------------------------------------</td>
</tr>
<tr>
<td>12 ya (2008)</td>
<td>The baiji, the Yangtze river dolphin, becomes functionally extinct, according to the IUCN Red List</td>
</tr>
<tr>
<td>9 ya (2011)</td>
<td>The western black rhinoceros is declared extinct</td>
</tr>
</tbody>
</table>

**Timeline of extinctions in the Holocene**

**10th millennium BCE**

- c. 9950 BCE – *Cuvieronius humboldti* survived in Chile until about this time.
- c. 9940 BCE - *Fratercula dowi* survived in the Channel Islands until about this time.
- c. 9680 BCE - *Euceratherium collinum* survived in Utah until about this time.
- c. 9650 BCE – *Arctotherium tarijense* survived in Uruguay until about this time.
- c. 9530 BCE – The short-faced bear *Arctodus simus* survived in Ohio until about this time.
- c. 9400 BCE – The Corsican and Sardinian canid *Cynotherium sardous* survived until about this time.
- c. 9390 BCE – *Eremotherium laurillardi* survived in Brazil until about this time.
- c. 9380 BCE – *Stockoceros* survived in New Mexico until about this time. *Equus conversidens* survived in Alberta until about this time.
- c. 9220 BCE – The pronghorn *Capromeryx* survived in New Mexico until about this time. *Equus scotti* survived until about this time.
- c. 9180 BCE - *Bison antiquus* survived in Alberta until about this time.
- c. 9150 BCE - The woodland musk ox *Symbos* survived in Michigan until about this time.
- c. 9135 BCE – *Panthera onca mesembrina* survived until about this time.
- c. 9110 BCE – The flat-headed peccary *Platygonus compressus* survived in Ohio until about this time.
- c. 9090 BCE – *Scelidotherium* and *Stegomastodon* survived in Brazil until about this time.
- c. 9080 BCE – The pygmy mammoth survived on Santa Rosa Island, California until about this time.
- c. 9030 BCE – *Bootherium bombifrons* survived in Alberta until about this time.

**9th millennium BCE**

- c. 8920 BCE – *Oreamnos harringtoni* survived in Arizona until about this time.
- c. 8735 BCE – *Hippidion saldiasi* survived in Chile until about this time.
c. 8445 BCE – The mastodont *Mammut* survived in Michigan until about this time.

* Martes nobilis and *Panthera leo atrox* survived until about this time.

* Castoroides* and the stag-moose *Cervalces* survived in Ohio until about this time.

c. 8420 BCE – *Equus neogeus*, *Glyptodon*, and *Toxodon* survived in Argentina until about this time.

8th millennium BCE

- c. 7930 BCE – The pampathere *Holmesina* survived in Florida until about this time, as did *Glossotherium*. *Tapirus veroensis* and *Palaeolama mirifica* survived until about this time.
- c. 7890 BCE – Mummified skin associated with the sloth *Nothrotheriops shastensis* indicates that the species may have survived in New Mexico until about this time.
- c. 7630 BCE – The sloth *Catonyx cuvieri* survived in Brazil until about this time.
- c. 7490 BCE – *Megalonyx jeffersonii* survived until about this time.
- c. 7490 BCE – The stilt-legged deer *Sangamona* survived in Missouri until about this time.
- c. 7470 BCE – The Cyprus dwarf elephant became extinct around this time.
- c. 7460 BCE – The peccary *Mylohyus* survived in Tennessee until about this time. *Smilodon fatalis* survived until about this time.
- c. 7450 BCE – The dire wolf *Canis dirus* survived in Missouri until about this time. Its extinction was probably caused by competition with *Canis lupus*, the extant gray wolf.
- c. 7290 BCE – The Cyprus dwarf hippopotamus became extinct at about this time.
- c. 7180 BCE – *Smilodon populator* survived in Brazil until about this time.

7th millennium BCE

- c. 6960 BCE – *Scelidodon chiliensis* survived in Peru until about this time.
- c. 6910 BCE – The primitive bison survived in the Taymyr Peninsula until this time.
- c. 6730 BCE – *Mammuthus columbi* survived in Saskatchewan until about this time. *Equus santaelenae* survived in Ecuador until about this time.
- c. 6720 BCE – *Ochotona whartoni* survived in eastern North America until about this time.
- c. 6689 BCE – *Mylohyus* survived in Chile until about this time.
- c. 6577 BCE – *Hemiauchenia* survived in Nevada until about this time.
- c. 6290 BCE – The camel *Camelops* survived in Arizona until about this time.
• c. 6275 BCE – *Bubo insularis* survived until about this time.
• c. 6050 BCE – *Megalotragus priscus* survived in South Africa until about this time.

6th millennium BCE

• c. 5914 BCE – The Cuban pauraque survived until about this time.
• c. 5620 BCE – *Antidorcas bondi* survived in South Africa until about this time.
• c. 5370 BCE – *Megatherium americanum* survived in Argentina until about this time.
• c. 5020 BCE – The Sardinian giant deer *Praemegaceros cazioti* survived until about this time.

5th millennium BCE

• c. 4950 BCE – *Dactylopsila kambuaya* and *Petauroides ayamaruensis* survived in New Guinea until about this time.
• c. 4866 BCE – Irish elk survived in the Urals and western Siberia until this time.
• c. 4605 BCE – The glyptodont *Doedicurus clavicaudatus* survived in Argentina until about this time.
• c. 4180 BCE – *Rallus eivissensis* survived on Ibiza until about this time.

4th millennium BCE

• c. 3010 BCE – The sloth *Parocnus browni* survived in Cuba until about this time.

3rd millennium BCE

• c. 2915 BCE - The canid *Dusicyon avus* survived in Argentina until about this time.
• c. 2835 BCE – The Balearic cave goat became extinct around this time.
• c. 2765 BCE – The North African buffalo *Pelorovis antiquus* survived until about this time. Its extinction may have been caused by competition for food and water with domestic cattle.
• c. 2550 BCE – The Bennu heron became extinct around this time, possibly due to degradation of its wetland habitat. It was last recorded in the Arabian Peninsula.
• c. 2441 BCE – The sloth *Neocnus comes* survived in Haiti until about this time.
• c. 2240 BCE – The sloth *Megalocnus rodens* and the Cuban cave rail survived in Cuba until about this time.
**2nd millennium BCE**

- c. 1900 BCE - *Antillothrix bernensis* survived on Hispaniola until about this time.
- c. 1780 BCE - The last known population of woolly mammoths on Wrangel Island died out, possibly due to a combination of climate change and hunting.
- c. 1520 BCE - The giant flightless megapode survived on New Caledonia until about this time.
- c. 1380 BCE - *Acratocnus odontrigonus*, formerly inhabiting Puerto Rico and Antigua, survived until about this time.
- c. 1300 BCE - *Thylogale christenseni* survived in New Guinea until about this time.

**1st millennium BCE**

- c. 790 BCE - *Megapodius alimentum* survived on Tonga until about this time.
- c. 530 BCE - *Microgale macphee* survived in Madagascar until about this time.
- c. 457 BCE - The rodent *Elasmodontomys obliquus* survived in Puerto Rico until about this time.
- c. 450 BCE - *Crocidura balsamifera* survived in Egypt until about this time.
- c. 341 BCE - *Archaeoindris fontoyonti* survived in Madagascar until about this time.
- c. 195 BCE - *Xenothrix mcgregori* survived until about this time.
- c. 110 BCE - *Archaeolemur edwardsi* survived in Madagascar until about this time.
- c. 100 BCE - Syrian elephant becomes extinct due to overhunting for ivory.
- c. 30 BCE - *Coua primaeva* survived in Madagascar until about this time.

**1st millennium CE**

**2nd century**

- c. 100 - The Maui highland apteribis survived on Maui until around this time.

**3rd century**

- c. 200 – The coastal kagu, Kanaka pigeon, New Caledonian gallinule, pile-builder megapode, and powerful goshawk survived until around this time.
- c. 256 – *Mesopropithecus globiceps* survived in Madagascar until about this time.
4th century

- c. 300 – The North African Elephant lives until about this time.

5th century

- c. 450 – The turtle genus *Meiolania* survived until this time on New Caledonia.

6th century

- c. 537 - *Hadropithecus stenognathus* survived in Madagascar until about this time.
- c. 540 – *Mesopropithecus pithecoides* survived in Madagascar until about this time.
- c. 570 – *Aloochen sirabensis* survived in Madagascar until around this time.

7th century

- c. 685 – The lava shearwater survived until around this time.

8th century

- c. 730 – *Pachylemur insignis* survived in Madagascar until about this time.
- c. 731 – The rodent *Heteropsomys insulans* survived in Puerto Rico until about this time.

9th century

- c. 836 – The coastal moa survived in New Zealand until about this time.
- c. 885 – *Daubentonia robusta* survived in Madagascar until about this time.

10th century

- c. 900 – The nene-nui survived on Maui until around this time.
- c. 915 – *Plesiorycteropus* survived in Madagascar until about this time.
- c. 950 – Sinoto's lorikeyet and the conquered lorikeyet survived until about this time.
- c. 996 – The New Zealand owlet-nightjar survived until about this time.
2nd millennium CE

12th century

- c. 1180 – The Maui Nui moa-nalo survived until around this time. The moa-nalo were large ducks and the Hawaiian Islands' major herbivores.
- c. 1190 – The Hunter Island penguin survived until around this time.

14th century

- c. 1320 – The lemur *Megaladapis edwardsi* survived in Madagascar until about this time.
- c. 1322 – The upland moa survived in New Zealand's South Island until around this time.
- c. 1326 – Mantell's moa survived in New Zealand's North Island until around this time.
- c. 1360 – *Nesophontes* survived in Cuba until around this time.

15th century

- c. 1400 – New Zealand's Haast's eagle, a giant bird of prey, becomes extinct. The eagle's main prey were various species of moa, which also went extinct.
- c. 1420 – The South Island giant moa survived in New Zealand's South Island until around this time.
- c. 1440 – The lemur *Palaeopropithecus ingens* survived in Madagascar until about this time.
- The moas of New Zealand became extinct, probably due to hunting.

16th century

- c. 1500–1550 – The Waitaha penguin of New Zealand's South Island became extinct.

17th century

- 1627 – The last known aurochs died in Poland. This large wild cattle formerly inhabited much of Europe, northern Africa, the Middle East, central Asia, and India.
- c. 1645 - Finsch's duck survived in New Zealand until around this time.
- 1662 - The last definite sighting of a dodo was made in Mauritius. The extinction was due to hunting, but also by the pigs, rats, dogs and cats brought to the island by settlers. The species has become an iconic symbol of animal extinction.
18th century

- 1768 - Steller's sea cow became extinct due to overhunting for meat and leather.
- 1773 – The Tahiti sandpiper died out after rats were introduced to its habitat in the Society Islands.
- 1774 – The Sardinian pika became extinct due to invasive species (foxes, cats, etc.) that were introduced to Sardinia and Corsica.
- 1777 - The Society parakeet population dies out on the Society Islands after vessels released pests.
- 1790 - The Lord Howe swamphen, also known as the white gallinule, becomes extinct.

19th century

- 1800 - The last known bluebuck was shot, making the species the first African antelope to be hunted to extinction by European settlers.
- 1825 – The mysterious starling died out.
- 1826 - The Mauritius blue pigeon becomes extinct due to excessive hunting.
- 1827 - The Tonga ground skink dies out from its only home in the Tongan Islands.
- 1852 - The last sighting of a great auk was made off the coast of Newfoundland. The bird was driven to extinction by hunting for its fat, feathers, meat, and oil.
- 1860 – The string tree from the island of St Helena becomes extinct because of habitat destruction.
- 1860 - The sea mink becomes extinct because of hunting for its fur.
- 1875 - The broad-faced potoroo was last recorded.
- 1876 - The Falkland Islands wolf became extinct.
- 1878 - Labrador duck declared extinct after last appearances in Long Island three years earlier.
- c. 1879 - The last known Atlas bear, Africa's only native bear, is killed by hunters in Morocco. The bear was heavily hunted and used for sport in the Roman Empire.
- 1880 – The eastern elk, a subspecies of elk in the US and Canada, is declared extinct.
- 1883 – The Quagga, a sub-species of the plains zebra, goes extinct.
- 1886 - The red alga known as Bennett’s seaweed from Australia disappears because of the massive human activities.
- 1889 - The last Hokkaido wolf dies from poisoning campaign.
- 1890 - The eastern hare-wallaby was last recorded.
20th century

1900s

- 1902 – The last known specimens of the Rocky Mountain locust are collected near Brandon, Manitoba.
- 1905 – The last known Honshū wolf of Japan dies in Nara Prefecture.
- 1907 – The huia, a native bird of New Zealand, is last seen. Habitat loss, hunting, and disease all played a role in its extinction.
- 1909 - The last known tarpan, a Polish wild horse, died in captivity.

1910s

- 1911 – The last Newfoundland wolf was shot.
- 1914 – The last passenger pigeon, Martha, died in captivity at the Cincinnati Zoo. Excessive hunting contributed to its extinction; it was formerly one of the world’s most abundant birds.
- 1918 – The last Carolina parakeet died in captivity at the Cincinnati Zoo. The bird, formerly inhabiting the southeastern United States, was driven to extinction by exploitation, deforestation, and competition with introduced bees.

1920s

- 1924 – The California grizzly bear is sighted for the last time.
- 1925 – The Kenai Peninsula wolf was driven to extinction.
- 1929 – *Acalypha wilderi* was last seen in the wild. This species may be synonymous with *A. raivavensis* and *A. tubuaiensis*, which would mean it is in fact not extinct globally.

1930s

- 1930 - Darwin's rice rat was last recorded in the Galápagos Islands. Its extinction was probably caused by the introduction of black rats.
- 1932 - "Booming Ben", the last known heath hen was seen on Martha's Vineyard, Massachusetts.
- 1933 - The cry pansy from Europe becomes extinct due to habitat loss and overcollection in the only place where it grew, France.
- 1934 - The indefatigable Galapagos mouse was last recorded. Its extinction was probably caused by the introduction of black rats.
• 1935 - The desert rat-kangaroo was last recorded.
• 1935 - The Mogollon mountain wolf and the Southern Rocky Mountains wolf were hunted to extinction.
• 1936 – The last thylacine died in captivity. Hunting, habitat loss, disease, and competition from domestic dogs all may have contributed to the extinction of the species.
• c. 1937 – The Bali tiger was last definitively seen around this time, but likely persisted into the 1940s or possibly even the early 1950s.
• 1939 – The toolache wallaby was last recorded.

1940s
• 1940 – The Cascade mountain wolf was hunted to extinction.
• 1942 – The Texas wolf was purposefully driven to extinction.
• 1942 – The last confirmed sighting of the Barbary lion, although unconfirmed reports surfaced until 1970.

1950s
• 1952 - Last reliable report of the Caribbean monk seal.
• 1952 - The Bernard's wolf was hunted to extinction.
• 1956 - The crescent nail-tail wallaby and imperial woodpecker were last recorded.
• 1957 – The Scioto madtom, a species of fish, is last collected.

1960s
• c. 1960 - The Mexican grizzly bear was exterminated around this time.
• 1962 - The red-bellied gracile opossum was last recorded in Argentina.
• 1964 - The Hawaii chaff flower of the Hawaiian islands becomes extinct because of habitat loss.
• 1965 - Last sighting of the turgid-blossom pearly mussel, an American mussel.
• 1966 – The last Arabian ostrich died around this time.

1970s
• c. 1970 - The Caspian tiger becomes extinct primarily due to habitat loss, hunting, and loss of prey.
• 1972 – The endemic to Jamaica Mason River myrtle becomes extinct.
• 1974 - The last known Japanese sea lion is captured off the coast of Rebun Island, Hokkaido.
• c. 1976 – Last sightings of the Javan tiger.

1980s

• 1981 – The Puhielelu hibiscadelphus becomes extinct.
• 1981 - Last sighting of the green-blossom pearly mussel, an American mussel.
• 1981 – The Southern gastric-brooding frog (*Rheobatrachus silus*) became extinct probably due to habitat destruction and disease.
• 1983 - Last unconfirmed spotting of the kouprey (*Bos sauveli*), last absolute confirmed spotting was in 1969/70. Declared as "most likely to be extinct" by the IUCN.
• 1983–84 – The 24-rayed sunstar (*Heliaster solaris*), the Galapagos black-spotted damselfish and the Galapagos stringweed likely become extinct due to climate change.
• 1985 – The Northern gastric-brooding frog (*Rheobatrachus vitellinus*) became extinct probably due to habitat destruction and disease.
• 1987 - The last Kaua‘i ʻōʻō (*Moho braccatus*), a male, is recorded singing a mating call. The species was never heard from again and was declared extinct.
• 1989 - The golden toad of Costa Rica becomes extinct, perhaps because of climate change.

1990s

• 1990 - The dusky seaside sparrow was officially declared extinct in December 1990. The last definite known individual died on 17 June 1987.
• 1994 – Saint Croix racer, a snake native to the Virgin Islands, declared extinct.
• 1994 - Levuana moth from Hawaii goes extinct.
• 1997 - The Hainan ormosia (a species of legume) which was native to China is no longer seen.

3rd millennium CE

21st century

2000s

• 2000 - "Celia", the last Pyrenean ibex, was found dead in 2000. However, in 2003, a female was cloned back into existence, but died shortly after birth due to defects in the lungs.
- 2003 – The last individual from the Saint Helena olive, which was grown in cultivation, dies off. The last plant in the wild had died in 1994.
- 2006 - A technologically sophisticated survey of the Yangtze River failed to find specimens of the baiji dolphin, prompting scientists to declare it functionally extinct.

**2010s**

- 2011 – The Eastern cougar was declared extinct. Last known individual was trapped and killed in 1938.
- 2011 – The western black rhinoceros was declared extinct.
- 2012 – The Japanese river otter (*Lutra lutra whitneyi*) declared extinct by the country's Ministry of the Environment, after not being seen for more than 30 years.
- 2012 – "Lonesome George", the last known specimen of the Pinta Island tortoise, died on 24 June 2012.
- 2013 – The Cape Verde giant skink was declared extinct.
- 2013 - The Formosan clouded leopard, previously endemic to the island of Taiwan, is officially declared extinct.
- 2014 – The Bermuda saw-whet owl was declared extinct after being described from fossils in 2012.
- 2017 - The Christmas Island forest skink was declared extinct, three years after the last known specimen died.
- 2019 - The Bramble Cay melomys was declared extinct.

**Timeline of chemistry**

**Pre-17th century**

**c. 3000 BC**

Egyptians formulate the theory of the Ogdoad, or the "primordial forces", from which all was formed. These were the elements of chaos, numbered in eight, that existed before the creation of the sun.

**c. 1200 BC**

Tapputi-Belatikallim, a perfume-maker and early chemist, was mentioned in a cuneiform tablet in Mesopotamia.
c. 450 BC
Empedocles asserts that all things are composed of four primal elements: earth, air, fire, and water, whereby two active and opposing forces, love and hate, or affinity and antipathy, act upon these elements, combining and separating them into infinitely varied forms.

c. 440 BC
Leucippus and Democritus propose the idea of the atom, an indivisible particle that all matter is made of. This idea is largely rejected by natural philosophers in favor of the Aristotelean view (see below).

c. 360 BC
Plato coins term ‘elements’ (stoicheia) and in his dialogue Timaeus, which includes a discussion of the composition of inorganic and organic bodies and is a rudimentary treatise on chemistry, assumes that the minute particle of each element had a special geometric shape: tetrahedron (fire), octahedron (air), icosahedron (water), and cube (earth).

c. 350 BC
Aristotle, expanding on Empedocles, proposes idea of a substance as a combination of matter and form. Describes theory of the Five Elements, fire, water, earth, air, and aether. This theory is largely accepted throughout the western world for over 1000 years.

c. 50 BC
Lucretius publishes *De Rerum Natura*, a poetic description of the ideas of atomism.

c. 300
Zosimos of Panopolis writes some of the oldest known books on alchemy, which he defines as the study of the composition of waters, movement, growth, embodying and disembodying, drawing the spirits from bodies and bonding the spirits within bodies.

c. 770
Abu Musa Jabir ibn Hayyan (aka Geber), an Arab/Persian alchemist who is "considered by many to be the father of chemistry", develops an early experimental method for chemistry, and isolates numerous acids, including hydrochloric acid, nitric acid, citric acid, acetic acid, tartaric acid, and aqua regia.

c. 1000
Abū al-Rayhān al-Bīrūnī and Avicenna, both Persian chemists, refute the practice of alchemy and the theory of the transmutation of metals.

c. 1167
Magister Salernus of the School of Salerno makes the first references to the distillation of wine.
c. 1220
Robert Grosseteste publishes several Aristotelian commentaries where he lays out an early framework for
the scientific method.

c 1250
Tadeo Alderotti develops fractional distillation, which is much more effective than its predecessors.

c 1260
St Albertus Magnus discovers arsenic and silver nitrate. He also made one of the first references to sulfuric
acid.

c. 1267
Roger Bacon publishes *Opus Maius*, which among other things, proposes an early form of the scientific
method, and contains results of his experiments with gunpowder.

c. 1310
Pseudo-Geber, an anonymous Spanish alchemist who wrote under the name of Geber, publishes several
books that establish the long-held theory that all metals were composed of various proportions
of sulfur and mercury. He is one of the first to describe nitric acid, aqua regia, and aqua fortis.

c. 1530
Paracelsus develops the study of iatrochemistry, a subdiscipline of alchemy dedicated to extending life,
thus being the roots of the modern pharmaceutical industry. It is also claimed that he is the first to use the
word "chemistry".

1597
Andreas Libavius publishes *Alchemia*, a prototype chemistry textbook.

17th and 18th centuries

1605
Sir Francis Bacon publishes *The Proficience and Advancement of Learning*, which contains a description of
what would later be known as the scientific method.

1605
Michal Sedziwój publishes the alchemical treatise *A New Light of Alchemy* which proposed the existence of
the "food of life" within air, much later recognized as oxygen.

1615
Jean Beguin publishes the *Tyrocinium Chymicum*, an early chemistry textbook, and in it draws the first-ever chemical equation.

1637

René Descartes publishes *Discours de la méthode*, which contains an outline of the scientific method.

1648

Posthumous publication of the book *Ortus medicinae* by Jan Baptist van Helmont, which is cited by some as a major transitional work between alchemy and chemistry, and as an important influence on Robert Boyle. The book contains the results of numerous experiments and establishes an early version of the law of conservation of mass.

1661

Robert Boyle publishes *The Sceptical Chymist*, a treatise on the distinction between chemistry and alchemy. It contains some of the earliest modern ideas of atoms, molecules, and chemical reaction, and marks the beginning of the history of modern chemistry.

1662

Robert Boyle proposes Boyle's law, an experimentally based description of the behavior of gases, specifically the relationship between pressure and volume.

1735

Swedish chemist Georg Brandt analyzes a dark blue pigment found in copper ore. Brandt demonstrated that the pigment contained a new element, later named cobalt.

1754

Joseph Black isolates carbon dioxide, which he called "fixed air".

1757

Louis Claude Cadet de Gassicourt, while investigating arsenic compounds, creates Cadet's fuming liquid, later discovered to be cacodyl oxide, considered to be the first synthetic organometallic compound.

1758

Joseph Black formulates the concept of latent heat to explain the thermochemistry of phase changes.
Henry Cavendish discovers hydrogen as a colorless, odourless gas that burns and can form an explosive mixture with air.

1773–1774

Carl Wilhelm Scheele and Joseph Priestley independently isolate oxygen, called by Priestley "dephlogisticated air" and Scheele "fire air".

1778

Antoine Lavoisier, considered "The father of modern chemistry", recognizes and names oxygen, and recognizes its importance and role in combustion.

1787

Antoine Lavoisier publishes *Méthode de nomenclature chimique*, the first modern system of chemical nomenclature.

1787

Jacques Charles proposes Charles's law, a corollary of Boyle's law, describes relationship between temperature and volume of a gas.

1789

Antoine Lavoisier publishes *Traité Élémentaire de Chimie*, the first modern chemistry textbook. It is a complete survey of (at that time) modern chemistry, including the first concise definition of the law of conservation of mass, and thus also represents the founding of the discipline of stoichiometry or quantitative chemical analysis.

1797

Joseph Proust proposes the law of definite proportions, which states that elements always combine in small, whole number ratios to form compounds.

1800

Alessandro Volta devises the first chemical battery, thereby founding the discipline of electrochemistry.

19th century

1803
John Dalton proposes Dalton's law, which describes relationship between the components in a mixture of gases and the relative pressure each contributes to that of the overall mixture.

1805

Joseph Louis Gay-Lussac discovers that water is composed of two parts hydrogen and one part oxygen by volume.

1808

Joseph Louis Gay-Lussac collects and discovers several chemical and physical properties of air and of other gases, including experimental proofs of Boyle's and Charles's laws, and of relationships between density and composition of gases.

1808

John Dalton publishes *New System of Chemical Philosophy*, which contains first modern scientific description of the atomic theory, and clear description of the law of multiple proportions.

1808

Jöns Jakob Berzelius publishes *Lärbok i Kemien* in which he proposes modern chemical symbols and notation, and of the concept of relative atomic weight.

1811

Amedeo Avogadro proposes Avogadro's law, that equal volumes of gases under constant temperature and pressure contain equal number of molecules.

1825

Friedrich Wöhler and Justus von Liebig perform the first confirmed discovery and explanation of isomers, earlier named by Berzelius. Working with cyanic acid and fulminic acid, they correctly deduce that isomerism was caused by differing arrangements of atoms within a molecular structure.

1827

William Prout classifies biomolecules into their modern groupings: carbohydrates, proteins and lipids.

1828

Friedrich Wöhler synthesizes urea, thereby establishing that organic compounds could be produced from inorganic starting materials, disproving the theory of vitalism.
Friedrich Wöhler and Justus von Liebig discover and explain functional groups and radicals in relation to organic chemistry.

1840

Germain Hess proposes Hess's law, an early statement of the law of conservation of energy, which establishes that energy changes in a chemical process depend only on the states of the starting and product materials and not on the specific pathway taken between the two states.

1847

Hermann Kolbe obtains acetic acid from completely inorganic sources, further disproving vitalism.

1848

Lord Kelvin establishes concept of absolute zero, the temperature at which all molecular motion ceases.

1849

Louis Pasteur discovers that the racemic form of tartaric acid is a mixture of the levorotatory and dextrotatory forms, thus clarifying the nature of optical rotation and advancing the field of stereochemistry.

1852

August Beer proposes Beer's law, which explains the relationship between the composition of a mixture and the amount of light it will absorb. Based partly on earlier work by Pierre Bouguer and Johann Heinrich Lambert, it establishes the analytical technique known as spectrophotometry.

1855

Benjamin Silliman, Jr. pioneers methods of petroleum cracking, which makes the entire modern petrochemical industry possible.

1856

William Henry Perkin synthesizes Perkin's mauve, the first synthetic dye. Created as an accidental byproduct of an attempt to create quinine from coal tar. This discovery is the foundation of the dye synthesis industry, one of the earliest successful chemical industries.

1857

Friedrich August Kekulé von Stradonitz proposes that carbon is tetravalent, or forms exactly four chemical bonds.

1859–1860

Gustav Kirchhoff and Robert Bunsen lay the foundations of spectroscopy as a means of chemical analysis, which lead them to the discovery of caesium and rubidium. Other workers soon used the same technique to discover indium, thallium, and helium.
1860

Stanislao Cannizzaro, resurrecting Avogadro's ideas regarding diatomic molecules, compiles a table of atomic weights and presents it at the 1860 Karlsruhe Congress, ending decades of conflicting atomic weights and molecular formulas, and leading to Mendeleev's discovery of the periodic law.

1862

Alexander Parkes exhibits Parkesine, one of the earliest synthetic polymers, at the International Exhibition in London. This discovery formed the foundation of the modern plastics industry.

1862

Alexandre-Emile Béguyer de Chancourtois publishes the telluric helix, an early, three-dimensional version of the periodic table of the elements.

1864

John Newlands proposes the law of octaves, a precursor to the periodic law.

1864

Lothar Meyer develops an early version of the periodic table, with 28 elements organized by valence.

1864

Cato Maximilian Guldberg and Peter Waage, building on Claude Louis Berthollet's ideas, proposed the law of mass action.

1865

Johann Josef Loschmidt determines exact number of molecules in a mole, later named Avogadro's number.

1865

Friedrich August Kekulé von Stradonitz, based partially on the work of Loschmidt and others, establishes structure of benzene as a six carbon ring with alternating single and double bonds.

1865

Adolf von Baeyer begins work on indigo dye, a milestone in modern industrial organic chemistry which revolutionizes the dye industry.

1869

Dmitri Mendeleev publishes the first modern periodic table, with the 66 known elements organized by atomic weights. The strength of his table was its ability to accurately predict the properties of as-yet unknown elements.
1873
Jacobus Henricus van 't Hoff and Joseph Achille Le Bel, working independently, develop a model of chemical bonding that explains the chirality experiments of Pasteur and provides a physical cause for optical activity in chiral compounds.

1876
Josiah Willard Gibbs publishes *On the Equilibrium of Heterogeneous Substances*, a compilation of his work on thermodynamics and physical chemistry which lays out the concept of free energy to explain the physical basis of chemical equilibria.

1877
Ludwig Boltzmann establishes statistical derivations of many important physical and chemical concepts, including entropy, and distributions of molecular velocities in the gas phase.

1883
Svante Arrhenius develops ion theory to explain conductivity in electrolytes.

1884
Jacobus Henricus van 't Hoff publishes *Études de Dynamique chimique*, a seminal study on chemical kinetics.

1884
Hermann Emil Fischer proposes structure of purine, a key structure in many biomolecules, which he later synthesized in 1898. Also begins work on the chemistry of glucose and related sugars.

1884
Henry Louis Le Chatelier develops Le Chatelier's principle, which explains the response of dynamic chemical equilibria to external stresses.

1885
Eugene Goldstein names the cathode ray, later discovered to be composed of electrons, and the canal ray, later discovered to be positive hydrogen ions that had been stripped of their electrons in a cathode ray tube. These would later be named protons.

1893
Alfred Werner discovers the octahedral structure of cobalt complexes, thus establishing the field of coordination chemistry.

1894–1898
William Ramsay discovers the noble gases, which fill a large and unexpected gap in the periodic table and led to models of chemical bonding.

1897

J. J. Thomson discovers the electron using the cathode ray tube.

1898

Wilhelm Wien demonstrates that canal rays (streams of positive ions) can be deflected by magnetic fields, and that the amount of deflection is proportional to the mass-to-charge ratio. This discovery would lead to the analytical technique known as mass spectrometry.

1898

Maria Sklodowska-Curie and Pierre Curie isolate radium and polonium from pitchblende.

c. 1900

Ernest Rutherford discovers the source of radioactivity as decaying atoms; coins terms for various types of radiation.

20th century

1903

Mikhail Semyonovich Tsvet invents chromatography, an important analytic technique.

1904

Hantaro Nagaoka proposes an early nuclear model of the atom, where electrons orbit a dense massive nucleus.

1905

Fritz Haber and Carl Bosch develop the Haber process for making ammonia from its elements, a milestone in industrial chemistry with deep consequences in agriculture.

1905

Albert Einstein explains Brownian motion in a way that definitively proves atomic theory.

1907

Leo Hendrik Baekeland invents bakelite, one of the first commercially successful plastics.
Robert Millikan measures the charge of individual electrons with unprecedented accuracy through the oil drop experiment, confirming that all electrons have the same charge and mass.

1909

S. P. L. Sørensen invents the pH concept and develops methods for measuring acidity.

1911

Antonius van den Broek proposes the idea that the elements on the periodic table are more properly organized by positive nuclear charge rather than atomic weight.

1911

The first Solvay Conference is held in Brussels, bringing together most of the most prominent scientists of the day. Conferences in physics and chemistry continue to be held periodically to this day.

1911

Ernest Rutherford, Hans Geiger, and Ernest Marsden perform the gold foil experiment, which proves the nuclear model of the atom, with a small, dense, positive nucleus surrounded by a diffuse electron cloud.

1912

William Henry Bragg and William Lawrence Bragg propose Bragg's law and establish the field of X-ray crystallography, an important tool for elucidating the crystal structure of substances.

1912

Peter Debye develops the concept of molecular dipole to describe asymmetric charge distribution in some molecules.

1913

Niels Bohr introduces concepts of quantum mechanics to atomic structure by proposing what is now known as the Bohr model of the atom, where electrons exist only in strictly defined orbitals.

1913

Henry Moseley, working from Van den Broek's earlier idea, introduces concept of atomic number to fix inadequacies of Mendeleev's periodic table, which had been based on atomic weight.

1913

Frederick Soddy proposes the concept of isotopes, that elements with the same chemical properties may have differing atomic weights.
1913
J. J. Thomson expanding on the work of Wien, shows that charged subatomic particles can be separated by their mass-to-charge ratio, a technique known as mass spectrometry.

1916
Gilbert N. Lewis publishes "The Atom and the Molecule", the foundation of valence bond theory.

1921
Otto Stern and Walther Gerlach establish concept of quantum mechanical spin in subatomic particles.

1923
Gilbert N. Lewis and Merle Randall publish Thermodynamics and the Free Energy of Chemical Substances, first modern treatise on chemical thermodynamics.

1923
Gilbert N. Lewis develops the electron pair theory of acid/base reactions.

1924
Louis de Broglie introduces the wave-model of atomic structure, based on the ideas of wave–particle duality.

1925
Wolfgang Pauli develops the exclusion principle, which states that no two electrons around a single nucleus may have the same quantum state, as described by four quantum numbers.

1926
Erwin Schrödinger proposes the Schrödinger equation, which provides a mathematical basis for the wave model of atomic structure.

1927
Werner Heisenberg develops the uncertainty principle which, among other things, explains the mechanics of electron motion around the nucleus.

1927
Fritz London and Walter Heitler apply quantum mechanics to explain covalent bonding in the hydrogen molecule, which marked the birth of quantum chemistry.

1929
Linus Pauling publishes Pauling's rules, which are key principles for the use of X-ray crystallography to deduce molecular structure.

1931

Erich Hückel proposes Hückel's rule, which explains when a planar ring molecule will have aromatic properties.

1931

Harold Urey discovers deuterium by fractionally distilling liquid hydrogen.

1932

James Chadwick discovers the neutron.

1932–1934

Linus Pauling and Robert Mulliken quantify electronegativity, devising the scales that now bear their names.

1935

Wallace Carothers leads a team of chemists at DuPont who invent nylon, one of the most commercially successful synthetic polymers in history.

1937

Carlo Perrier and Emilio Segrè perform the first confirmed synthesis of technetium-97, the first artificially produced element, filling a gap in the periodic table. Though disputed, the element may have been synthesized as early as 1925 by Walter Noddack and others.

1937

Eugene Houdry develops a method of industrial scale catalytic cracking of petroleum, leading to the development of the first modern oil refinery.

1937

Pyotr Kapitsa, John Allen and Don Misener produce supercooled helium-4, the first zero-viscosity superfluid, a substance that displays quantum mechanical properties on a macroscopic scale.

1938

Otto Hahn discovers the process of nuclear fission in uranium and thorium.
Linus Pauling publishes *The Nature of the Chemical Bond*, a compilation of a decades worth of work on chemical bonding. It is one of the most important modern chemical texts. It explains hybridization theory, covalent bonding and ionic bonding as explained through electronegativity, and resonance as a means to explain, among other things, the structure of benzene.

**1940**

Edwin McMillan and Philip H. Abelson identify neptunium, the lightest and first synthesized transuranium element, found in the products of uranium fission. McMillan would found a lab at Berkeley that would be involved in the discovery of many new elements and isotopes.

**1941**

Glenn T. Seaborg takes over McMillan's work creating new atomic nuclei. Pioneers method of neutron capture and later through other nuclear reactions. Would become the principal or co-discoverer of nine new chemical elements, and dozens of new isotopes of existing elements.

**1945**

Jacob A. Marinsky, Lawrence E. Glendenin, and Charles D. Coryell perform the first confirmed synthesis of Promethium, filling in the last "gap" in the periodic table.

**1945–1946**

Felix Bloch and Edward Mills Purcell develop the process of nuclear magnetic resonance, an analytical technique important in elucidating structures of molecules, especially in organic chemistry.

**1951**

Linus Pauling uses X-ray crystallography to deduce the secondary structure of proteins.

**1952**

Alan Walsh pioneers the field of atomic absorption spectroscopy, an important quantitative spectroscopy method that allows one to measure specific concentrations of a material in a mixture.

**1952**

Robert Burns Woodward, Geoffrey Wilkinson, and Ernst Otto Fischer discover the structure of ferrocene, one of the founding discoveries of the field of organometallic chemistry.

**1953**

James D. Watson and Francis Crick propose the structure of DNA, opening the door to the field of molecular biology.

**1957**

Jens Skou discovers Na⁺/K⁺-ATPase, the first ion-transporting enzyme.
1958
Max Perutz and John Kendrew use X-ray crystallography to elucidate a protein structure, specifically sperm whale myoglobin.

1962
Neil Bartlett synthesizes xenon hexafluoroplutinate, showing for the first time that the noble gases can form chemical compounds.

1962
George Olah observes carbocations via superacid reactions.

1964
Richard R. Ernst performs experiments that will lead to the development of the technique of Fourier transform NMR. This would greatly increase the sensitivity of the technique, and open the door for magnetic resonance imaging or MRI.

1965
Robert Burns Woodward and Roald Hoffmann propose the Woodward–Hoffmann rules, which use the symmetry of molecular orbitals to explain the stereochemistry of chemical reactions.

1966
Hitoshi Nozaki and Ryōji Noyori discovered the first example of asymmetric catalysis (hydrogenation) using a structurally well-defined chiral transition metal complex.

1970
John Pople develops the Gaussian program greatly easing computational chemistry calculations.

1971
Yves Chauvin offered an explanation of the reaction mechanism of olefin metathesis reactions.

1975
Karl Barry Sharpless and group discover a stereoselective oxidation reactions including Sharpless epoxidation, Sharpless asymmetric dihydroxylation, and Sharpless oxyamination.

1985
Harold Kroto, Robert Curl and Richard Smalley discover fullerenes, a class of large carbon molecules superficially resembling the geodesic dome designed by architect R. Buckminster Fuller.
1991

Sumio Iijima uses electron microscopy to discover a type of cylindrical fullerene known as a carbon nanotube, though earlier work had been done in the field as early as 1951. This material is an important component in the field of nanotechnology.

1994

First total synthesis of Taxol by Robert A. Holton and his group.

1995

Eric Cornell and Carl Wieman produce the first Bose–Einstein condensate, a substance that displays quantum mechanical properties on the macroscopic scale.

Timeline of events related to per- and polyfluoroalkyl substances

The timeline of events related to per- and polyfluoroalkyl substances (PFASs) includes events related to the discovery, development, manufacture, marketing, uses, concerns, litigation, regulation, and legislation, involving the man-made PFASs, particularly perfluorooctanoic acid (PFOA) and perfluorooctanesulfonic acid (PFOS), and about the companies, mainly DuPont and 3M that manufactured and marketed them. Perfluorinated compounds are a group of hundreds of man-made compounds collectively known as PFAS. Fluorosurfactants (PFAS) have been produced and marketed by DuPont under its trademark Teflon—a fluorinated polymer. PFAS compounds and their derivatives are widely used in many products from water resistant textiles to fire-fighting foam. A replacement for PFOAs and PFOS—GenX chemicals and PFBS—are "man-made, fluorinated organic chemicals that are part of the larger group —per- and polyfluoroalkyl substances (PFAS).

PFAS are commonly found in every American household, and in products as diverse as non-stick cookware, stain resistant furniture and carpets, wrinkle free and water repellent clothing, cosmetics, lubricants, paint, pizza boxes, popcorn bags, and many other everyday products.

- **1802** Éleuthère Irénée du Pont, who had emigrated from France after the French Revolution, founded a company to produce gunpowder called E. I. du Pont de Nemours and Company in Brandywine Creek, near Wilmington, Delaware.
- E. I. du Pont de Nemours and Company was renamed DuPont.
- **1902** John Dwan, Hermon Cable, Henry Bryan, and William A. McGonagle co-founded Minnesota Mining and Manufacturing Company (3M) in 1902 in Two Harbors, Minnesota, in 1902, as a corundum mining operation. The men did not know at that time that "corundum was really another low-grade mineral called anorthosite."
• **1930** General Motors and DuPont formed Kinetic Chemicals to produce Freon.

• **1935** On 22 January, E. I. du Pont de Nemours & Co., Inc., formally opened the Haskell Laboratory of Industrial Toxicology on the grounds of the Experimental Station of the company. It was at that time, "one of the first in-house toxicology facilities." It was established on the advice of a DuPont in-house doctor named George Gehrmann. According to a 1935 news item in the *Industrial and Engineering Chemistry* journal, the purpose of the du Pont facility was to thoroughly test all du Pont products as a public health measure to determine the effects of du Pont's finished products on the "health of the ultimate consumer " and that the products "are safe" "before they are placed on the market". The Haskell Laboratory facilities were "not to be employed in the development of compounds useful in therapeutics." The laboratory was named after Harry G. Haskell, du Pont's vice president, whose son, Harry G. Haskell Jr. (b. 1921 – ) was mayor of Wilmington of Wilmington, Delaware from 1969 to 1973, and served as Delaware's Congressman from 1957-1959. W. F. von Oettingen was the first director of Haskell Laboratory of Industrial Toxicology. Lammot du Pont II (1880 – 1952) was president of E. I. du Pont de Nemours & Co., Inc. from 15 March 1926 until he retired at the age of 60 on 20 May 1940. He was succeeded by Walter S. Carpenter Jr..

• **6 April 1938** Roy J. Plunkett (1910 – 1994), who was then a 27-year old research chemist who worked at the DuPont's Jackson Laboratory in Deepwater, New Jersey, was working with gases related to DuPont's Freon refrigerants, when an experiment he was conducting produced an unexpected new product.—tetrafluoroethylene resin. He had accidentally invented polytetrafluoroethylene (PTFE), a saturated fluorocarbon polymer—the "first compound in the family of Perfluorinated compounds (PFCs), "to be marketed commercially."(Lyons 2007) It took ten years of research before polytetrafluoroethylene (PTFE) was introduced under its trade name Teflon, where it became known for being "extremely heat-tolerant and stick-resistant." In 1985, Plunkett was named to the National Inventors' Hall of Fame for the invention of Teflon, which "has been of great personal benefit to people—not just indirectly, but directly to real people whom I know." Plunkett described the discovery and development at the 1986 American Chemical Society symposium on the History of High Performance Polymers. He said that he and his assistant, Jack Rebok, had opened a tetrafluoroethylene (TFE) cylinder to examine an unusual white powder that had prevented the TFE gas from flowing out. Upon opening the cylinder, they found that the white powder was "packed onto the bottom and lower sides of the cylinder." The sample of gaseous TFE in the cylinder had polymerized spontaneously into a white, waxy solid. The polymer was polytetrafluoroethylene (PTFE). In 1945, DuPont commercialized PTFE as Teflon. They found that PTFE was resistant to corrosion, had low surface friction, and high heat resistance. Tetrafluoroethylene (TFE) can cyclize with a wide variety of compounds which led to the creation of a range of organofluorine compounds.

• **1950s** For decades—beginning in the 1950s—3M manufactured PFAS at its plant in Cottage Grove in Washington County, Minnesota. 3M, with 10,000 employees in Maplewood in Ramsey County where it is headquartered—is the largest employer in Maplewood.
1950s According to the 2016 lawsuit brought against 3M by Lake Elmo, Minnesota, 3M had "disposed of PFCs and PFC-containing waste at a facility it owned and operated in Oakdale, Minnesota (the "Oakdale Facilities")" during the 1950s. The Environmental Protection Agency Superfund, Oakdale Dump, includes three non-contiguous properties—Abresch, Brockman, and Eberle sites—that 3M used for waste disposal "from the late 1940s until the 1950s". The Oakdale Dump contaminated residential drinking water wells with volatile organic compounds (VOCs) and heavy metals. It was converted into a city park after extensive cleanup.

1951 "The DuPont chemical plant in Washington, West Virginia, began using PFOA in its manufacturing process."

1954 R. A. Dickison, who was employed at DuPont, received an inquiry about C8's "possible toxicity."

1956 A study undertaken by Gordon I. Nordby and J. Murray Luck at Stanford University found that "PFAS binds to proteins in human blood."

1960s DuPont "buried about 200 drums of C8 on the banks of the Ohio River near the plant."

1963 The United States Navy scientists began to work with 3M to develop aqueous film-forming foams (AFFF). The US military began to use Aqueous Film Forming Foams (AFFF) since its development in 1963 and patented AFFF in 1967.

1961 A DuPont in-house toxicologist said C8 was toxic and should be "handled with extreme care."

1962 3M moved its headquarters from Saint Paul, Minnesota—where it had been located since 1910, to its headquarters at 3M Center in Maplewood, Minnesota.

1965 John Zapp, who was then director of DuPont's Haskell Laboratories, "received a memo describing preliminary studies that showed that even low doses of a related surfactant could increase the size of rats' livers, a classic response to exposure to a poison."

1967 In the wake of the 1967 USS Forrestal fire, which happened off the coast of north Vietnam—"one of the worst disasters in U.S. naval history"—in which 134 people were killed and the U.S. Navy aircraft carrier was almost destroyed, the US Navy began to make it mandatory for its vessels to carry Aqueous Film Forming Foams (AFFF) on board. A rocket, that was accidentally launched by a power surge, caused a fire that burned all night when it hit a "fuel tank, igniting leaking fuel and causing nine bombs to explode."

October 1969 In a laboratory that he shared with his father, Bill Gore, while experimenting with ways of "stretching extruded PTFE into pipe-thread tape", and after "series of unsuccessful experiments", Robert (Bob) Gore (b. 1937), accidentally discovered that a "sudden, accelerated yank" caused the PTFE to "stretch about 800%, which resulted in the transformation of solid PTFE into a microporous structure that was about 70% air." At the time Bob Gore was working with W. L. Gore and Associates, a company established by his father Wilbert (Bill) Gore (1912 – 1986), who had worked at Remington Arms DuPont plant in Ilion, New York during World War II as a chemical engineer.
- **Early 1970s** According to court documents in the lawsuit against 3M, the company had "disposed of PFCs and PFC-containing waste at the city of Lake Elmo's Washington County Landfill".

- **1970s** The Quartz said that according to a document on file with the US Environmental Protection Agency, and discovered by The Intercept's Sharon Lerner in June 2019, reported that the document was on file with the US Environmental Protection Agency, that Minnesota Mining and Manufacturing Company (3M) "knew as early as the 1970s that PFAS was accumulating in human blood." 3M's own experiments on rats and monkeys concluded that PFAS compounds "should be regarded as toxic."

- **1970s** In the 1970s researchers at 3M documented the presence of PFOS and PFOA—the "two best-known PFAS compounds"—in fish.

- **1970s** In Australia, firefighting foams containing PFAS had been used "extensively" since the 1970s, because they were very effective in "fighting liquid fuel fires."

- **1978** 3M scientists, Hugh J. Van Noordwyk and Michael A. Santoro published an article on 3M's hazardous waste program in the *Environmental Health Perspectives* (EHP) journal, which is supported by the United States Department of Health and Human Services's (DHHS) National Institute of Environmental Health Sciences (NIEHS), an institutes of the National Institutes of Health (NIH). The authors said that 3M considered "thermal destruction of hazardous wastes" as the "best method for their disposal". By 1978, 3M had built seven incineration facilities throughout the United States on "3M manufacturing plant sites at Brownwood, Texas, Cordova, Illinois, Cottage Grove, Minnesota, Decatur, Alabama, Hartford City, Indiana, Nevada, Missouri, and White City, Oregon."²⁴⁷

- **September 1982** 3M found drums stockpiled and buried deep in the trenches of the Oakdale Dump's Abresch site.

- **1983** Following approval by the Federal Environmental Protection Agency and the Minnesota Pollution Control Agency in July, 3M, described by The New York Times as a "diversified manufacturing concern" announced their $6 million clean up of what would become known as the Oakdale Dump.

- **1998** Cincinnati, Ohio-based Robert Bilott, an American environmental attorney with Taft, Stettinius & Hollister LLP, took a case representing Wilbur Tennant, a Parkersburg, West Virginia farmer, whose herd of cattle had been decimated by strange symptoms that Tennant blamed on DuPont's Washington Works facilities.

- **1998** The United States Environmental Protection Agency (EPA) "was first alerted to the risks" of PFAS—man-made "forever chemicals" that "never break down once released and they build up in our bodies". The EPA's Stephen Johnson, said in Barboza's 18 May 2000 Times article that The EPA first talked to 3M in 1998 after they were first alerted to 3M's 1998 laboratory rat study in which "male and female rats were given doses of the chemical and then mated. When a pregnant rat continued to get regular doses of about 3.2 milligrams per kilogram of body weight, most of the offspring died within four days." According to
Johnson, "With all that information, [the EPA] finally talked to 3M and said that raises a number of concerns. What are you going to do?"

- **Summer of 1999** Bilott filed a federal suit in the Southern District of West Virginia on behalf of Wilbur Tennant against DuPont. A report commissioned by the EPA and DuPont and authored by 6 veterinarians—3 chosen by the EPA and the others by DuPont—found that Tennant's cattle had died because of Tennant's "poor husbandry", which included "poor nutrition, inadequate veterinary care and lack of fly control." The report said that DuPont was not responsible for the cattle's health problems.

- **2000** In a highly cited 2001 article in the *Environmental Science & Technology*, published by the American Chemical Society, John P. Giesy and Kurunthachalam Kannan reported "for the first time, on the global distribution of perfluorooctanesulfonate (PFOS), a fluorinated organic contaminant." Based on the findings of their 2000 study, Giesy and Kannan said that "PFOS were widely detected in wildlife throughout the world" and that "PFOS is widespread in the environment." They said that "PFOS can bioaccumulate to higher trophic levels of the food chain" and that the "concentrations of PFOS in wildlife are less than those required to cause adverse effects in laboratory animals."

"PFOS was measured in the tissues of wildlife, including, fish, birds, and marine mammals. Some of the species studied include bald eagles, polar bears, albatrosses, and various species of seals. Samples were collected from urbanized areas in North America, especially the Great Lakes region and coastal marine areas and rivers, and Europe. Samples were also collected from a number of more remote, less urbanized locations such as the Arctic and the North Pacific Oceans. ... Concentrations of PFOS in animals from relatively more populated and industrialized regions, such as the North American Great Lakes, Baltic Sea, and Mediterranean Sea, were greater than those in animals from remote marine locations. Fish-eating, predatory animals such as mink and bald eagles contained concentrations of PFOS that were greater than the concentrations in their diets."


- **May 17 2000** Prior to May 2000, when 3M stopped manufacturing "PFOS (perfluorooctanesulphonate)-based fluoro surfactants using the electrochemical fluorination process" which is a "class of chemicals known as perfluorochemicals (PFCs) in a classification of firefighting foam called Aqueous Film Forming Foams (AFFF). Prior to 2000, the "most common PFCs" used in Aqueous Film Forming Foams (AFFF) were "PFOS and its derivatives." According to Robert Avsec, who was Fire Chief Robert Avsec of the Chesterfield, Virginia Fire and EMS Department for 26 years, in fires classified as Class B—which includes fires that are difficult to extinguish, such as "fires that involve petroleum or other flammable liquids"—firefighters use a classification of firefighting foam called Aqueous Film Forming Foams (AFFF) foams. Concerns have been raised about PFCs contaminating groundwater sources.

- **17 May 2000** 3M stopped manufacturing "PFOS (perfluorooctanesulphonate)-based fluoro surfactants using the electrochemical fluorination process."
• **17 May 2000** Pulitzer Prize-winning journalist, David Barboza reported that 3M had voluntarily agreed to stop manufacturing Scotchgard because of their "corporate responsibility" to be "environmentally friendly. Their own tests had proven that PFOS, an agent that 3M used in the fabrication of Scotchgard—was proven to linger in the environment and in humans. Barboza said that 3M's "decision to drop Scotchgard" would likely affect DuPont's use of PFOAs in the manufacturing of Teflon. William E. Coyne, the head of the then St.Paul-based 3M's research and development, said that PFOS "does not "decompose, it's inert—it's persistent; it's like a rock."

• **18 May 2000** Barboza corrected his 2017 May report saying that 3M had not acted voluntarily to be environmentally friendly as they had claimed. E.P.A. officials said that while, "it did not see an immediate safety risk for consumers using products now on the market...if 3M had not acted they would have taken steps to remove the product from the market." EPA had become "concerned about potential long-term health risks to humans after a 3M study showed that the chemical, perfluorooctanyl sulfonate, lingered for years in human blood and animal tissue and that high doses were known to kill laboratory rats."

• **August 2000** In his research in preparation for the court case, Bilott found an article mentioning the "little-known substance"—a surfactant—called perfluorooctanoic acid" (PFOA) or C8—had been found in DuPont's Dry Run Creek, adjacent to Tennant farm, and Bilott requested "more information on the chemical. This concerned DuPont's lawyer, Bernard J. Reilly, who raised concerns at DuPont's Delaware headquarters.

• **Fall of 2000** A court order that Bilott had requested, forced DuPont to submit 110,000 pages of documents dated back to the 1950s of DuPont's "private internal correspondence, medical and health reports and confidential studies conducted by DuPont scientists".

• **2001** DuPont settled the lawsuit filed by Billot on behalf of Tennant for an undisclosed sum.

• **March 2001** After spending months poring through the DuPont's documents, attorney Bilott sent a 972-page submission to directors of all relevant regulatory authorities, including the United States Environmental Protection Agency (EPA)'s Christie Whitman, and the US AG, John Ashcroft, demanding "immediate action be taken to regulate PFOA and provide clean water to those living near" [DuPont's Washington Works facilities].

• **June 2001** According to a June 2007 article in the *Industrial Fire Journal* (IFJ), the Firefighting Foam Coalition (FFC) was created by "[m]anufacturers of firefighting foams and the fluorosurfactants they contain" as a "focal point" for co-operation with "several environmental authorities" regarding "potential environmental impacts of its products." The article said that there has been a heightened awareness on the part of the "fire protection industry" on its environmental impact as concerns were raised about ozone depletion in the late 1980s.

• **31 August 2001** A state court action was filed in West Virginia by Bilott, Harry Deitzler, an attorney with Hill, Peterson, Carper, Bee and Deitzler, and others on behalf of thirteen individuals in the "Leach case"—Jack W. Leach, William Parrish, Joseph K. Kiger, Darlene G. Kiger, Judy See, Rick See, Jack L. Cottrell,
Virginia L. Cottrell, Carrie K. Allman, Roger D. Allman, Sandy Cowan, Aaron B. McConnell, and Angela D. McConnell—DuPont, Leach Case”). Tennant had settled his lawsuit privately with DuPont. In their "Amended class action complaint" attorneys for the plaintiffs, said that in October and November of 2000 and July of 2001, DuPont had sent notices to Lubeck Public Service District (LPSD) customers, informing them that there was PFOA in the LPSD's water system. In 2000, West Virginia recognized the medical-monitoring claim which allows a plaintiff to "sue retroactively for damages". Bilott filed the class-action suit in August 2001 in the West Virginia state court, "even though four of the six affected water districts lay across the Ohio border."

- **2002** DuPont's Fayetteville, North Carolina facility began to manufacture C8.

- **2002** Since 2002, when the Minnesota Department of Health (MDH) first developed "Health Based Values for PFOS and PFOA", the MDH has also developed "health-based guidance values for PFOS, PFOA, PFBS, and PFBA, and uses the PFOS value as a surrogate for evaluating PFHxS (in lieu of sufficient PFHxS-specific toxicological information)." MDH had begun partnering with Minnesota Pollution Control Agency (MPCA) to investigate PFAS in "drinking water investigations east of Saint Paul near the 3M Cottage Grove plant and related legacy waste disposal sites in Washington County."

- **2002** Minnesota Department of Health (MDH) "Public Health Laboratory developed an analytical method tailored to the PFAS found in the 3M waste disposal sites." They also "developed two other methods with longer analyte lists to evaluate AFFF and other sites." These investigations resulted in the discovery of "groundwater contamination covering over 150 square miles, affecting the drinking water supplies of over 140,000 Minnesotans. Over 2,600 private wells have been sampled and 798 drinking water advisories issued."

- **2003** Weinberg Group's then Vice-President of Product Defense, P. Terrence Gaffney wrote a 5-page letter urging DuPont to prepare a defense strategy for future litigation related to the health impacts of PFOAs in Parkersburg, West Virginia. The letter was mentioned in an *Environmental Science & Technology* article called "The Weinberg proposal" by Paul D. Thacker. Gaffney wrote that, "DuPont must shape the debate at all levels." He offered several strategies which included the establishment of "blue ribbon panels", the coordination of papers on PFOA and on junk science, the "publication of papers and articles dispelling the alleged nexus between PFOA and teratogenicity as well as other claimed harm."

- **2003** Gale D. Pearson, then a local lawyer in Cottage Grove, was one of the first people to look into contaminated ground water in Cottage Grove. In 2003, lawyers had contacted her regarding a personal injury case about contaminated water near a [DuPont/Chemours] plant in West Virginia where they manufactured Teflon in a process that used PFOAs, a type of PFAS. She knew that 3M had manufactured PFOAs in their Cottage Grove facility. Pearson discovered through the Environmental Working Group (EWS) that PFAS were not just found in Washington County, Minnesota and West Virginia, but all over the world. 3M had dumped waste in the Cottage Grove "when it was still just farmland" and in other nearby farmlands in Washington County. Pearson and her team hired a chemist to test soil and water
samples on the properties where 3M had dumped the chemicals. Blood samples from the local population in the affected area were also tested for PFAS. Pearson said that the laboratory tests revealed that there was a "hotspot of contamination in the blood of the community."

- **19 June 2003** Ted Schaefer, a chemist who worked for 3M in Australia patented a fire fighting foam that did not contain PFOS or any other persistent ingredients. Immediately after 3M chose to no longer manufacture PFOS in 2000, the company deployed Schaefer to develop a replacement for the Aqueous Film Forming Foams (AFFF). By 2002, Schaefer, who had worked for years on "foams used to put out forest fires", developed a fluorine-free foam that was able to put out jet fuel fires within 46 seconds. The International Civil Aviation Organization standard was 60-seconds.

- **October 2003** A report by Oregon State University's Jennifer Field which was based on "data on fluorosurfactants in groundwater at three military sites where AFFF was used to train fire responders" concluded that the "perfluoroalkyl sulfonates and perfluoroalkyl carboxylates found in the groundwater came from PFOS-based AFFF agents". Field said that "the 6:2 fluorotelomer sulfonate was likely the primary breakdown product of the six-carbon fluorosurfactants contained in fluorotelomer-based AFFF." Field's report was presented at an October 2003 EPA workgroup, which "determined that modern AFFF agents" were "not likely to be a source of PFCAs such as PFHxS and PFOA in the environment. EPA concluded that existing data "provided no evidence that these fluorosurfactants biodegrade into PFOA or its homologs..." according to a 2007 Industrial Fire Journal (IFJ) article.

- **2004** PFCs were detected in the Oakdale facilities and the landfill by the Minnesota Pollution Control Agency (MPCA) and it was "revealed that the PFCs had leached from the Oakdale Facilities and the Landfill into the groundwater aquifers serving as Lake Elmo's drinking water supply."

- **2004** According to 2004 report by ChemRisk—an "industry risk assessor" hired by DuPont, Dupont's Parkersburg, West Virginia-based Washington Works plant had "dumped, poured and released" over 1.7 million pounds of C8 or perfluorooctanoic acid (PFOA) into the environment between 1951 and 2003.

- **23 November 2004** The Circuit Court of Wood County, West Virginia class action lawsuit, *Leach, et al v. E. I. DuPont deNemours and Co.* against DuPont, on behalf of residents in the Parkersburg regional area—including Little Hocking, Ohio, Lubeck Public Service District, West Virginia, the city of Belpre, Ohio, Tuppers Plains, Ohio, Mason County Public Service District, West Virginia and the village of Pomeroy, Ohio—whose water systems were affected by C-8 water contamination was certified by Judge George W. Hill on 23 November 2004. The settlement in 2004 "established a court-approved scientific panel to determine what types of ailments are likely linked to PFOA exposure." In a 25 November 2019, case in the District court of Ohio, the judge "rejected DuPont's claims that the court had misinterpreted the 2004 class-action settlement, and that the court should have applied Ohio’s tort reform act, which caps the amount of some types of damages plaintiffs can receive." The settlement included a requirement that DuPont "pay the costs of medical monitoring for nearly 100,000 people in the area." Over "3,500 residents opted out of the class-action settlement to instead pursue individual lawsuits."
• **2005-2006** The C8 Health Project undertaken by the C8 Science Panel "surveyed 69,030 individuals" who had "lived, worked, or attended school for ≥ 1 year in one of six contaminated water districts near the plant between 1950 and 3 December 2004."

• **2005** According to a 2005 *Journal of Vinyl and Additive Technology* article that was cited in *The Intercept*, "PFAS chemicals are used widely to help with the molding and extrusions of plastic".

• **2006** The EPA brokered a voluntary agreement with DuPont and eight other major companies to phase out the use of PFOS and PFOA in the United States.

• **January 2007** Dennis Paustenbach, who was the founder of ChemRisk, co-authored an article entitled "A methodology for estimating human exposure to perfluorooctanoic acid (PFOA): a retrospective exposure assessment of a community (1951-2003)" in the *Journal of Toxicology and Environmental Health*, in which the authors said that " The predicted historical lifetime and average daily estimates of PFOA intake by persons who lived within 5 miles of the plant over the past 50 yr were about 10,000-fold less than the intake of the chemical not considered as a health risk by an independent panel of scientists who recently studied PFOA."

• **2009** 3M shut down their Saint Paul Plant. In 1910, 3M had moved its headquarters and manufacturing facilities from Duluth to one building on Forest Street in Dayton's Bluff, Saint Paul, one of Saint Paul's oldest communities on the east side of the Mississippi River. Over the years, it expanded into a 61-acre 3M campus. Whirlpool's factory, Hamm's/Stroh's brewery and other industries were also located along a diagonal that ran through the Dayton Bluff neighbourhood, East 7 Street. The three companies shut down in "rapid succession." when 3M closed down its Dayton's Bluff operation in phases, it was the last of the three leaving the community. These companies had provided good-paying jobs in the neighbourhood so their closing left Dayton Bluff as a "boulevard of broken dreams"—a "once-thriving neighborhood descended into a defeating spiral of decay, witnessed by vacant lots, boarded-up storefronts and rising crime." When the St. Paul's development agency, the Port Authority, took over the campus, it was renamed Beacon Bluff. then the Saint Paul Plant continued to be active until 2009. near the diagonal-running artery that connects one of the East Side's oldest communities directly to downtown St. Paul. a diagonal The East 7 Street, which ran through the Dayton Bluff neighborhood was home to For years, E. 7th Street was St. Paul's own boulevard of broken dreams.

• **2010** Lake Elmo, Minnesota, a city of about 8,000 people in Washington State, Minnesota—sued 3M when PFAS chemicals, known as 'forever chemicals', were found to have contaminated Lake Elmo's drinking water.

• **2014** The EPA's Federal Facilities Restoration and Reuse Office (FFRRO) developed and published a fact sheet which provided a "summary of the emerging contaminants perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA), including physical and chemical properties, environmental and health impacts, existing federal and state guidelines, detection and treatment methods."
• **2016** The EPA "published a voluntary health advisory for PFOA and PFOS" which warned that "exposure to the chemicals at levels above 70 parts per trillion, total, could be dangerous."

• **2016** The city of Lake Elmo, Minnesota sued 3M a second time for polluting their drinking water with PFAS chemicals. 3M filed for a dismissal was refused in 2017.

• **2016** In a 17 October 2016 article by Robert Avsec, who was Fire Chief Robert Avsec of the Chesterfield, Virginia Fire and EMS Department for 26 years, manufacturers of the firefighting foam had "moved away from PFOS and its derivatives as a result of legislative pressure." They began to develop and market "fluorine-free...firefighting foams"—foams "that do not use fluorochemicals"

• **13 February 2017** The 2001 class-action suit that Bilott had filed against DuPont, on behalf of the Parkersburg area residents, resulted in DuPont agreeing to pay $671 million in cash to settle about 3,550 personal injury claims involving a leak of perfluorooctanoic acid—PFOA or C-8—used to make Teflon in its Parkersburg, West Virginia-based Washington Works facilities. DuPont denied any wrongdoing.

• **2017** 3M net sales for 2017 were $31.657 billion compared to $30.109 billion in 2016. On 13 February 2017 Chemours shares rose 13 percent and DuPont shares rose 1 percent.

• **22 May 2017** According to a 2 November 2018, *Bloomberg* article, the Minnesota Health Department (MHD) notified the office of the Mayor of Cottage Grove, Myron Bailey, that the MHD had "set a new, [stricter], lower level for a type of unregulated chemical found in Minnesota's drinking water" and that Cottage Grove's water "would exceed the new threshold" that was necessary to "better protect infants and young children." Bailey called a state of emergency.

• **2017** The Fire Fighting Foam Coalition's 2017 fact sheet said that the short-chain (C6) fluorosurfactants which are replacing the longer C8 in AFFF are "low in toxicity and not considered to be bioaccumulative based on current regulatory criteria."

• **Fall 2017** When abnormally high levels of PFAS were found in Belmont, Michigan, it became one of the first places where PFAS contaminations caught the attention of the media. The contamination was attributed to Wolverine Worldwide, a footwear company that had used to Scotchgard to "treat shoe leather" and had dumped their waste in that area decades ago.

• **late 2017** The Australian Government's established an Expert Health Panel for PFAS to "advise the Australian Government on the evidence for potential health impacts associated with PFAS exposure and recommend priority areas for future research." Their report was submitted in March 2018.

• **2017** PFAS are on the Government of Canada's 2019 chart of substances that are prohibited by Canadian Environmental Protection Act, 1999 (CEPA) and by Prohibition of Certain Toxic Substances Regulations, 2012. These substances are under these regulations because they are "among the most harmful" and "have been declared toxic to the environment and/or human health", are "generally persistent and bioaccumulative." The "regulations prohibit the manufacture, use, sale, offer for sale or import of the toxic substances listed below, and products containing them, with a limited number of exemptions."
The Australian National University was commissioned by the Australian Government to conduct a health study to examine patterns of PFAS contamination and potential implications for human health at Defence sites in Australia, with a focus on three sites—Williamtown in New South Wales, Oakey in Queensland and Katherine in the Northern Territory.

5 January 2017 The jury in a case against DuPont, awarded compensation of $10.5 million to the plaintiff in the U.S. District Court in Columbus, with U.S. Chief District Judge Edmund A. Sargus Jr. presiding. The attorney for the plaintiff, Gary J. Douglas urged the jury to award punitive damages that reflected DuPont's assets and income—as revealed by the witness for the plaintiff—Robert Johnson a forensic economist. Johnson said that DuPont has $18.8 billion in assets "that can be converted to cash" and "has net sales of $68 million a day." Johnson said that DuPont makes "$2 million...in 42 minutes."

10 January 2018 According to the U.S. Department of Health & Human Services's Agency for Toxic Substances and Disease Registry (ATSDR) website which was last reviewed on 10 January 2018, the "health effects of PFOS, PFOA, PFHxS, and PFNA have been more widely studied than other per- and polyfluoroalkyl substances (PFAS). Some, but not all, studies in humans with PFAS exposure have shown that certain PFAS may affect growth, learning, and behavior of infants and older children, lower a woman’s chance of getting pregnant, interfere with the body’s natural hormones, increase cholesterol levels, affect the immune system, and increase the risk of cancer."

20 February 2018 The state of Minnesota "settled its lawsuit against the 3M Company in return for a settlement of $850 million". Their Minnesota Pollution Control Agency (MPCA) interactive map indicates the location of dozens of wells under advisory because of contaminated ground water in southern Minnesota where Mississippi River winds past Saint Paul's. After the trial concluded, the Attorney General of Minnesota published some of the documents related to the case, saying that said the public had a right to know as 3M had been aware of health risks for decades.

2018 Department of Health & Human Services's Agency for Toxic Substances and Disease Registry (ATSDR) was about to publish its assessment of PFAS chemicals, with a focus on two specific chemicals from the PFAS class—PFOA and PFOS—that have "contaminated water supplies near military bases, chemical plants and other sites from New York to Michigan to West Virginia" which showed that the PFAS chemicals "endanger human health at a far lower level than EPA has previously called safe." The HHS updated ATSDR study would have warned that exposure to PFOA and PFOS at less than one-sixth of the EPAs current guideline of 70 parts per trillion, "could be dangerous for sensitive populations like infants and breastfeeding mothers."

30 January 2018 According to an article by the Center for Science and Democracy's director, Michael Halpern and posted by the Union of Concerned Scientists (UCS), in early 2018, Nancy Beck, Deputy Assistant Administrator at the Office of Chemical Safety and Pollution Prevention (OCSPP), the Office of Land and Emergency Management (OLEM), Office of Research and Development (ORD)—three branches of the Environmental Protection Agency (EPA)—exchanged chains of emails with Office of Management
and Budget (OMB), the United States Department of Defense (DoD), HHS, and the Pentagon, to put pressure on the Agency for Toxic Substances and Disease Registry (ATSDR) to censor a report that measured the "health effects" of PFAS that are "found in drinking water and household products throughout the United States." Beck wrote to EPA staff including, Jennifer Orme-Zavaleta, Ryan Jackson, and Peter Grevatt, and Mike Flynn (EPA) in regards to "PFAS meeting with ATSDR" that the "implications for susceptible populations came as a surprise to OCSPP staff." Beck is "one of the EPA political appointees with ties to the chemical industry involved in the effort to prevent the study from being released." An email by an unidentified Trump administration aid that was forwarded by Office of Management and Budget's(OMB) James Herz, said that "The public, media, and Congressional reaction to these numbers is going to be huge. The impact to EPA and [the Defense Department] is going to be extremely painful. We (DoD and EPA) cannot seem to get ATSDR to realize the potential public relations nightmare this is going to be." one unidentified White House aide said in an email forwarded on 30 Jan. by James Herz, a political appointee who oversees environmental issues at the OMB. The email added: "The impact to EPA and [the Defense Department] is going to be extremely painful. We (DoD and EPA) cannot seem to get ATSDR to realize the potential public relations nightmare this is going to be."

- **March 2018** The United States Department of Defense's (DoD)'s report to Congress said that test that they conducted showed that the amount of PFAS chemicals in water supplies near 126 DoD facilities, "exceeded the current safety guidelines". The DoD has "used foam containing" PFAS chemicals "in exercises at bases across the country". The DoD therefore, "risks the biggest liabilities" in relation to the use of PFAS chemicals according to *Politico*.

- **March 2018** In March 2018, the PFAS Expert Health Panel on PFAS submitted their commissioned report to the Australian government.

- **14 May 2018** *Politico* gained access to the email chains and published the story in May, saying that Scott Pruitt's EPA had worked with the Trump administration to block the publication of the Agency for Toxic Substances and Disease Registry (ATSDR) report.

- **21 June 2018** The Department of Health & Human Services's Agency for Toxic Substances and Disease Registry (ATSDR) 697-page draft report for public comment, "Toxicological Profile for Perfluoroalkyls", was finally released.

- **November 14, 2018** According to *The Guardian*, a November 14, 2018 EPA draft assessment said that "animal studies showing effects on the kidneys, liver, immune system and more from GenX," the chemicals manufactured by Chemours—a corporate spin-off of DuPont, in Fayetteville, North Carolina. GenX chemicals are used PFOA (C8) for manufacturing fluoropolymers such as teflon, and in products such as firefighting foam, paints, food packaging, paints, outdoor fabrics, and cleaning products.

- **19 March 2019** The *Concord Monitor* reported that the United States Congress House Bill 494, which was to be introduced in March, would compel Department of Environmental Services (DES) of the state of New Hampshire to enact new standards that would force "polluters to stop the flow of toxins" from
the Superfund Coakley landfill site in North Hampton and Greenland that threatens the drinking water of five Seacoast towns and contaminate surface water bodies in the surrounding area. The contamination represents "some of the highest levels ever found anywhere of PFNA", one of the perfluorinated chemicals.

- **May 2019** In May 2019, the Stockholm Convention COP "decided to eliminate production and use of two important toxic POPs, PFOA and Dicofol" as recommended by the United Nation's Stockholm Convention's Persistent Organic Pollutants Review Committee (POPRC-15).

- **29 May 2019** The city of Lake Elmo, Minnesota and 3M reached a settlement over the drinking water contamination lawsuit. 3M will pay $2.7 million to Lake Elmo's water account and will "transfer 180 acres of farmland" to Lake Elmo which is "valued at $1.8 million."

- **June 2019** In what was described as a "huge step toward cleaning up the prevalence of—and prevent further contamination from—PFAS chemicals in ground, surface and drinking water" the Department of Environmental Services of the state of New Hampshire submitted a "final rulemaking proposal" for new, lower maximum contaminant levels (MCLs)/drinking water standards and ambient groundwater quality standards (AGQS) for four per- and polyfluoroalkyl substances (PFAS): perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOS), perfluorononanoic acid (PFNA) and perfluorohexanesulfonic acid (PFHxS)." When implemented on 1 October, following the approval of and adoption by New Hampshire's Joint Legislative Committee on Administrative Rules (JLCAR) on 18 July, New Hampshire will be able to "compel polluters to clean up contaminated sites." One of the contaminated sites is the "Coakley landfill in North Hampton and Greenland."

- **2019** The state of New Hampshire filed a lawsuit against Dupont, 3M, and other companies, for their roles in the crisis in drinking water contamination in the United States. The lawsuit claims that the polluted water is the result of the manufacture and use of perfluorinated chemicals, a group of more than 4,000 compounds collectively known as PFAS.

- **23 September 2019** On 23 September 2019 the CDC and ATSDR announced that they had "established cooperative agreements with seven partners to study the human health effects of exposures to per- and polyfluoroalkyl substances (PFAS) through drinking water at locations across the nation."

- **September 2019** Andrew R. Wheeler, EPA Administrator, met with industry lobbyists and said that "Congressional efforts to clean up legacy PFAS pollution in the National Defense Authorization Act for fiscal 2020" were "just not workable." Wheeler refuses to "designate PFAS chemicals as "hazardous substances" under the Superfund law."

- **1 October 2019** A lawsuit was filed in the Merrimack County Superior Court by 3M, Plymouth Water & Sewer District, and two others against the state Department of Environmental Services to prevent the new permitted levels for PFOA, PFOS, PFNA, and PFHxS from being implemented.

- **4 October 2019** At the 15th meeting of the United Nation's Stockholm Convention's Persistent Organic Pollutants Review Committee (POPRC-15) held in Rome, on 4 October, over 100 scientific experts representing many countries, "recommended that a group of hazardous chemicals"—"Perfluorohexane.
sulfonic acid (PFHxS), its salts, and PFHxS-related compounds”—be eliminated in order to better protect human health and the environment from its harmful impacts.” PFHxS and PFHxS-related salts and compounds are a "group of industrial chemicals used widely in a number of consumer goods as a surfactant and sealant including in carpets, leather, clothing, textiles, fire-fighting foams, papermaking, printing inks and non-stick cookware. They are known to be harmful to human health including the nervous system, brain development, endocrine system and thyroid hormone." Perfluorohexane sulfonic acid (PFHxS) is one of a number of common PFAS chemicals. Other common PFAS chemicals include Perfluorooctanoic acid (PFOA), Perfluorooctane sulfonate (PFOS), Perfluorooctanesulfonamide (PFOSA), perfluorooctanoic acid (PFHpA), Perfluorononanoic acid (PFNA), Perfluorodecanoic acid (PFDA), Perfluorobutane sulfonic acid (PFBS), and Heptafluorobutyric acid (HFBA).

- **25 November 2019** Judge Edmund A. Sargus Jr. of the U.S. District Court for the Southern District of Ohio ruled in favor of the plaintiffs against DuPont in the court case *E.I. du Pont de Nemours & Co. C-8 Pers. Injury Litig., S.D. Ohio, No. 2:13-md-02433, 11/25/19.* Judge Sargus blocked DePont from defending against claims that were decided in the set of previous trials, involving residents of Ohio and West Virginia who say PFAS from E.I. du Pont de Nemours & Co.'s Washington Works manufacturing facility, which was located along the Ohio River, "contaminated their water, and caused cancer and other diseases". The company had argued that their "release of PFOA amounted to negligence".

**Timeline of atomic and subatomic physics**

**Early beginnings**

- In 6th century BCE, Acharya Kanada proposed that all matter must consist of indivisible particles and called them "anu". He proposes examples like ripening of fruit as the change in the number and types of atoms to create newer units.
- 430 BCE Democritus speculates about fundamental indivisible particles—calls them "atoms"

**The beginning of chemistry**

- 1766 Henry Cavendish discovers and studies hydrogen
- 1778 Carl Scheele and Antoine Lavoisier discover that air is composed mostly of nitrogen and oxygen
- 1781 Joseph Priestley creates water by igniting hydrogen and oxygen
- 1800 William Nicholson and Anthony Carlisle use electrolysis to separate water into hydrogen and oxygen
• 1803 John Dalton introduces atomic ideas into chemistry and states that matter is composed of atoms of different weights
• 1805 (approximate time) Thomas Young conducts the double-slit experiment with light
• 1811 Amedeo Avogadro claims that equal volumes of gases should contain equal numbers of molecules
• 1832 Michael Faraday states his laws of electrolysis
• 1871 Dmitri Mendeleyev systematically examines the periodic table and predicts the existence of gallium, scandium, and germanium
• 1873 Johannes van der Waals introduces the idea of weak attractive forces between molecules
• 1885 Johann Balmer finds a mathematical expression for observed hydrogen line wavelengths
• 1887 Heinrich Hertz discovers the photoelectric effect
• 1894 Lord Rayleigh and William Ramsay discover argon by spectroscopically analyzing the gas left over after nitrogen and oxygen are removed from air
• 1895 William Ramsay discovers terrestrial helium by spectroscopically analyzing gas produced by decaying uranium
• 1896 Antoine Becquerel discovers the radioactivity of uranium
• 1896 Pieter Zeeman studies the splitting of sodium D lines when sodium is held in a flame between strong magnetic poles
• 1897 Emil Wiechert, Walter Kaufmann and J.J. Thomson discover the electron
• 1898 Marie and Pierre Curie discovered the existence of the radioactive elements radium and polonium in their research of pitchblende
• 1898 William Ramsay and Morris Travers discover neon, and negatively charged beta particles

Timeline of classical mechanics

• 4th century BC - Aristotle invents the system of Aristotelian physics, which is later largely disproved
• 4th century BC - Babylonian astronomers calculate Jupiter's position using the mean speed theorem
• 260 BC - Archimedes works out the principle of the lever and connects buoyancy to weight
• 60 - Hero of Alexandria writes Metrica, Mechanics (on means to lift heavy objects), and Pneumatics (on machines working on pressure)
• 350 - Themistius states, that static friction is larger than kinetic friction
• 6th century - John Philoponus says that by observation, two balls of very different weights will fall at nearly the same speed. He therefore tests the equivalence principle
• 1021 - Al-Biruni uses three orthogonal coordinates to describe point in space
- 1000-1030 - Alhazen and Avicenna develop the concepts of inertia and momentum
- 1100-1138 - Avempace develops the concept of a reaction force
- 1100-1165 - Hibat Allah Abu'l-Barakat al-Baghdadi discovers that force is proportional to acceleration rather than speed, a fundamental law in classical mechanics
- 1121 - Al-Khazini publishes *The Book of the Balance of Wisdom*, in which he develops the concepts of gravity at-a-distance. He suggests that the gravity varies depending on its distance from the center of the universe, namely Earth
- 1340-1358 - Jean Buridan develops the theory of impetus
- 14th century - Oxford Calculators and French collaborators prove the mean speed theorem
- 14th century - Nicole Oresme derives the times-squared law for uniformly accelerated change. Oresme, however, regarded this discovery as a purely intellectual exercise having no relevance to the description of any natural phenomena, and consequently failed to recognise any connection with the motion of accelerating bodies
- 1500-1528 - Al-Birjandi develops the theory of "circular inertia" to explain Earth's rotation
- 16th century - Francesco Beato and Luca Ghini experimentally contradict aristotelian view on free fall.
- 16th century - Domingo de Soto suggests that bodies falling through a homogeneous medium are uniformly accelerated. Soto, however, did not anticipate many of the qualifications and refinements contained in Galileo's theory of falling bodies. He did not, for instance, recognise, as Galileo did, that a body would fall with a strictly uniform acceleration only in a vacuum, and that it would otherwise eventually reach a uniform terminal velocity
- 1581 - Galileo Galilei notices the timekeeping property of the pendulum
- 1589 - Galileo Galilei uses balls rolling on inclined planes to show that different weights fall with the same acceleration
- 1638 - Galileo Galilei publishes *Dialogues Concerning Two New Sciences* (which were materials science and kinematics) where he develops, amongst other things, Galilean transformation
- 1645 - Ismaël Bullialdus argues that "gravity" weakens as the inverse square of the distance
- 1651 - Giovanni Battista Riccioli and Francesco Maria Grimaldi discover the Coriolis effect
- 1658 - Christiaan Huygens experimentally discovers that balls placed anywhere inside an inverted cycloid reach the lowest point of the cycloid in the same time and thereby experimentally shows that the cycloid is the tautochrone
- 1668 - John Wallis suggests the law of conservation of momentum
- 1676-1689 - Gottfried Leibniz develops the concept of vis viva, a limited theory of conservation of energy
1687 - Isaac Newton publishes his Philosophiae Naturalis Principia Mathematica, in which he formulates Newton's laws of motion and Newton's law of universal gravitation

1690 - James Bernoulli shows that the cycloid is the solution to the tautochrone problem

1691 - Johann Bernoulli shows that a chain freely suspended from two points will form a catenary

1691 - James Bernoulli shows that the catenary curve has the lowest center of gravity of any chain hung from two fixed points

1696 - Johann Bernoulli shows that the cycloid is the solution to the brachistochrone problem

1707 - Gottfried Leibniz probably develops the principle of least action

1710 - Jakob Hermann shows that Laplace–Runge–Lenz vector is conserved for a case of the inverse-square central force

1714 - Brook Taylor derives the fundamental frequency of a stretched vibrating string in terms of its tension and mass per unit length by solving an ordinary differential equation

1733 - Daniel Bernoulli derives the fundamental frequency and harmonics of a hanging chain by solving an ordinary differential equation

1734 - Daniel Bernoulli solves the ordinary differential equation for the vibrations of an elastic bar clamped at one end

1739 - Leonhard Euler solves the ordinary differential equation for a forced harmonic oscillator and notices the resonance

1742 - Colin Maclaurin discovers his uniformly rotating self-gravitating spheroids

1743 - Jean le Rond d'Alembert publishes his "Traite de Dynamique", in which he introduces the concept of generalized forces and D'Alembert's principle

1747 - d'Alembert and Alexis Clairaut publish first approximate solutions to the three-body problem

1749 - Leonhard Euler derives equation for Coriolis acceleration

1759 - Leonhard Euler solves the partial differential equation for the vibration of a rectangular drum

1764 - Leonhard Euler examines the partial differential equation for the vibration of a circular drum and finds one of the Bessel function solutions

1776 - John Smeaton publishes a paper on experiments relating power, work, momentum and kinetic energy, and supporting the conservation of energy

1788 - Joseph Louis Lagrange presents Lagrange's equations of motion in the Méchanique Analitique

1789 - Antoine Lavoisier states the law of conservation of mass

1803 - Louis Poinsot develops idea of angular momentum conservation (this result was previously known only in the case of conservation of areal velocity)
• 1813 - Peter Ewart supports the idea of the conservation of energy in his paper On the measure of moving force
• 1821 - William Hamilton begins his analysis of Hamilton's characteristic function and Hamilton–Jacobi equation
• 1829 - Carl Friedrich Gauss introduces Gauss's principle of least constraint
• 1834 - Carl Jacobi discovers his uniformly rotating self-gravitating ellipsoids
• 1834 - Louis Poinsot notes an instance of the intermediate axis theorem
• 1835 - William Hamilton states Hamilton's canonical equations of motion
• 1838 - Liouville begins work on Liouville's theorem
• 1841 - Julius Robert von Mayer, an amateur scientist, writes a paper on the conservation of energy but his lack of academic training leads to its rejection
• 1847 - Hermann von Helmholtz formally states the law of conservation of energy
• First half of XIX century - Cauchy develops his momentum equation and his stress tensor
• 1851 - Léon Foucault shows the Earth's rotation with a huge pendulum (Foucault pendulum)
• 1870 - Rudolf Clausius deduces virial theorem
• 1902 - James Jeans finds the length scale required for gravitational perturbations to grow in a static nearly homogeneous medium
• 1915 - Emmy Noether proves Noether's theorem, from which conservation laws are deduced
• 1952 - Parker develops a tensor form of the virial theorem
• 1978 - Vladimir Arnold states precise form of Liouville–Arnold theorem
• 1983 - Mordehai Milgrom proposes Modified Newtonian dynamics
• 1992 - Udwadia and Kalaba create Udwadia–Kalaba equation

The age of quantum mechanics

• 1887 Heinrich Rudolf Hertz discovers the photoelectric effect that will play a very important role in the development of the quantum theory with Einstein's explanation of this effect in terms of quanta of light
• 1896 Wilhelm Conrad Röntgen discovers the X-rays while studying electrons in plasma; scattering X-rays—that were considered as 'waves' of high-energy electromagnetic radiation—Arthur Compton will be able to demonstrate in 1922 the 'particle' aspect of electromagnetic radiation.
• 1900 Paul Villard discovers gamma-rays while studying uranium decay
• 1900 Johannes Rydberg refines the expression for observed hydrogen line wavelengths
• 1900 Max Planck states his quantum hypothesis and blackbody radiation law
• 1902 Philipp Lenard observes that maximum photoelectron energies are independent of illuminating intensity but depend on frequency
• 1902 Theodor Svedberg suggests that fluctuations in molecular bombardment cause the Brownian motion
• 1905 Albert Einstein explains the photoelectric effect
• 1906 Charles Barkla discovers that each element has a characteristic X-ray and that the degree of penetration of these X-rays is related to the atomic weight of the element
• 1909 Hans Geiger and Ernest Marsden discover large angle deflections of alpha particles by thin metal foils
• 1909 Ernest Rutherford and Thomas Royds demonstrate that alpha particles are doubly ionized helium atoms
• 1911 Ernest Rutherford explains the Geiger–Marsden experiment by invoking a nuclear atom model and derives the Rutherford cross section
• 1911 Jean Perrin proves the existence of atoms and molecules with experimental work to test Einstein's theoretical explanation of Brownian motion
• 1911 Ștefan Procopiu measures the magnetic dipole moment of the electron
• 1912 Max von Laue suggests using crystal lattices to diffract X-rays
• 1912 Walter Friedrich and Paul Knipping diffract X-rays in zinc blende
• 1913 William Henry Bragg and William Lawrence Bragg work out the Bragg condition for strong X-ray reflection
• 1913 Henry Moseley shows that nuclear charge is the real basis for numbering the elements
• 1913 Niels Bohr presents his quantum model of the atom
• 1913 Robert Millikan measures the fundamental unit of electric charge
• 1913 Johannes Stark demonstrates that strong electric fields will split the Balmer spectral line series of hydrogen
• 1914 James Franck and Gustav Hertz observe atomic excitation
• 1914 Ernest Rutherford suggests that the positively charged atomic nucleus contains protons
• 1915 Arnold Sommerfeld develops a modified Bohr atomic model with elliptic orbits to explain relativistic fine structure
• 1916 Gilbert N. Lewis and Irving Langmuir formulate an electron shell model of chemical bonding
• 1917 Albert Einstein introduces the idea of stimulated radiation emission
• 1918 Ernest Rutherford notices that, when alpha particles were shot into nitrogen gas, his scintillation detectors showed the signatures of hydrogen nuclei.
• 1921 Alfred Landé introduces the Landé g-factor
1922 Arthur Compton studies X-ray photon scattering by electrons demonstrating the 'particle' aspect of electromagnetic radiation.

1922 Otto Stern and Walther Gerlach show "spin quantization"

1923 Lise Meitner discovers what is now referred to as the Auger process

1924 Louis de Broglie suggests that electrons may have wavelike properties in addition to their 'particle' properties; the wave–particle duality has been later extended to all fermions and bosons.

1924 John Lennard-Jones proposes a semiempirical interatomic force law

1924 Satyendra Bose and Albert Einstein introduce Bose–Einstein statistics

1924 George Uhlenbeck and Samuel Goudsmit postulate electron spin

1925 Wolfgang Pauli states the quantum exclusion principle for electrons

1925 Pierre Auger discovers the Auger process (2 years after Lise Meitner)

1925 Werner Heisenberg, Max Born, and Pascual Jordan formulate quantum matrix mechanics

1926 Erwin Schrödinger states his nonrelativistic quantum wave equation and formulates quantum wave mechanics

1926 Erwin Schrödinger proves that the wave and matrix formulations of quantum theory are mathematically equivalent

1926 Oskar Klein and Walter Gordon state their relativistic quantum wave equation, now the Klein–Gordon equation

1926 Enrico Fermi discovers the spin–statistics connection, for particles that are now called 'fermions', such as the electron (of spin-1/2).

1926 Paul Dirac introduces Fermi–Dirac statistics

1926 Gilbert N. Lewis introduces the term "photon", thought by him to be "the carrier of radiant energy."

1927 Clinton Davisson, Lester Germer, and George Paget Thomson confirm the wavelike nature of electrons

1927 Werner Heisenberg states the quantum uncertainty principle

1927 Max Born interprets the probabilistic nature of wavefunctions

1927 Walter Heitler and Fritz London introduce the concepts of valence bond theory and apply it to the hydrogen molecule.

1927 Thomas and Fermi develop the Thomas–Fermi model

1927 Max Born and Robert Oppenheimer introduce the Born–Oppenheimer approximation

1928 Chandrasekhar Raman studies optical photon scattering by electrons

1928 Paul Dirac states his relativistic electron quantum wave equation
- 1928 Charles G. Darwin and Walter Gordon solve the Dirac equation for a Coulomb potential
- 1928 Friedrich Hund and Robert S. Mulliken introduce the concept of molecular orbital
- 1929 Oskar Klein discovers the Klein paradox
- 1929 Oskar Klein and Yoshio Nishina derive the Klein–Nishina cross section for high energy photon scattering by electrons
- 1929 Nevill Mott derives the Mott cross section for the Coulomb scattering of relativistic electrons
- 1930 Paul Dirac introduces electron hole theory
- 1930 Erwin Schrödinger predicts the zitterbewegung motion
- 1930 Fritz London explains van der Waals forces as due to the interacting fluctuating dipole moments between molecules
- 1931 John Lennard-Jones proposes the Lennard-Jones interatomic potential
- 1931 Irène Joliot-Curie and Frédéric Joliot observe but misinterpret neutron scattering in paraffin
- 1931 Wolfgang Pauli puts forth the neutrino hypothesis to explain the apparent violation of energy conservation in beta decay
- 1931 Linus Pauling discovers resonance bonding and uses it to explain the high stability of symmetric planar molecules
- 1931 Paul Dirac shows that charge quantization can be explained if magnetic monopoles exist
- 1931 Harold Urey discovers deuterium using evaporation concentration techniques and spectroscopy
- 1932 John Cockcroft and Ernest Walton split lithium and boron nuclei using proton bombardment
- 1932 James Chadwick discovers the neutron
- 1932 Werner Heisenberg presents the proton–neutron model of the nucleus and uses it to explain isotopes
- 1932 Carl D. Anderson discovers the positron
- 1933 Ernst Stueckelberg (1932), Lev Landau (1932), and Clarence Zener discover the Landau–Zener transition
- 1933 Max Delbrück suggests that quantum effects will cause photons to be scattered by an external electric field
- 1934 Irène Joliot-Curie and Frédéric Joliot bombard aluminium atoms with alpha particles to create artificially radioactive phosphorus-30
- 1934 Leó Szilárd realizes that nuclear chain reactions may be possible
- 1934 Enrico Fermi publishes a very successful model of beta decay in which neutrinos were produced.
- 1934 Lev Landau tells Edward Teller that non-linear molecules may have vibrational modes which remove the degeneracy of an orbitally degenerate state (Jahn–Teller effect)
- 1934 Enrico Fermi suggests bombarding uranium atoms with neutrons to make a 93 proton element
- 1934 Pavel Cherenkov reports that light is emitted by relativistic particles traveling in a nonscintillating liquid
- 1935 Hideki Yukawa presents a theory of the nuclear force and predicts the scalar meson
- 1935 Albert Einstein, Boris Podolsky, and Nathan Rosen put forth the EPR paradox
- 1935 Henry Eyring develops the transition state theory
- 1935 Niels Bohr presents his analysis of the EPR paradox
- 1936 Alexandru Proca formulates the relativistic quantum field equations for a massive vector meson of spin-1 as a basis for nuclear forces
- 1936 Eugene Wigner develops the theory of neutron absorption by atomic nuclei
- 1936 Hermann Arthur Jahn and Edward Teller present their systematic study of the symmetry types for which the Jahn–Teller effect is expected
- 1937 Carl Anderson proves experimentally the existence of the pion predicted by Yukawa's theory.
- 1937 Hans Hellmann finds the Hellmann–Feynman theorem
- 1937 Seth Neddermeyer, Carl Anderson, J.C. Street, and E.C. Stevenson discover muons using cloud chamber measurements of cosmic rays
- 1939 Richard Feynman finds the Hellmann–Feynman theorem
- 1939 Otto Hahn and Fritz Strassmann bombard uranium salts with thermal neutrons and discover barium among the reaction products
- 1939 Lise Meitner and Otto Robert Frisch determine that nuclear fission is taking place in the Hahn–Strassmann experiments
- 1942 Enrico Fermi makes the first controlled nuclear chain reaction
- 1942 Ernst Stueckelberg introduces the propagator to positron theory and interprets positrons as negative energy electrons moving backwards through spacetime
- 1943 Sin-Itiro Tomonaga publishes his paper on the basic physical principles of quantum electrodynamics
- 1947 Willis Lamb and Robert Retherford measure the Lamb–Retherford shift
- 1947 Cecil Powell, César Lattes, and Giuseppe Occhialini discover the pi meson by studying cosmic ray tracks
- 1947 Richard Feynman presents his propagator approach to quantum electrodynamics
- 1948 Hendrik Casimir predicts a rudimentary attractive Casimir force on a parallel plate capacitor
- 1951 Martin Deutsch discovers positronium
- 1952 David Bohm propose his interpretation of quantum mechanics
1953 Robert Wilson observes Delbruck scattering of 1.33 MeV gamma-rays by the electric fields of lead nuclei
1953 Charles H. Townes, collaborating with J. P. Gordon, and H. J. Zeiger, builds the first ammonia maser
1954 Chen Ning Yang and Robert Mills investigate a theory of hadronic isospin by demanding local gauge invariance under isotopic spin space rotations, the first non-Abelian gauge theory
1955 Owen Chamberlain, Emilio Segrè, Clyde Wiegand, and Thomas Ypsilantis discover the antiproton
1956 Frederick Reines and Clyde Cowan detect antineutrino
1956 Chen Ning Yang and Tsung Lee propose parity violation by the weak nuclear force
1956 Chien Shiung Wu discovers parity violation by the weak force in decaying cobalt
1957 Gerhart Luders proves the CPT theorem
1958 Marcus Sparnaay experimentally confirms the Casimir effect
1959 Yakir Aharonov and David Bohm predict the Aharonov–Bohm effect
1960 R.G. Chambers experimentally confirms the Aharonov–Bohm effect
1961 Murray Gell-Mann and Yuval Ne'eman discover the Eightfold Way patterns, the SU(3) group
1961 Jeffrey Goldstone considers the breaking of global phase symmetry
1962 Leon Lederman shows that the electron neutrino is distinct from the muon neutrino
1963 Eugene Wigner discovers the fundamental roles played by quantum symmetries in atoms and molecules

The formation and successes of the Standard Model

1964 Murray Gell-Mann and George Zweig propose the quark/aces model
1964 Peter Higgs considers the breaking of local phase symmetry
1964 John Stewart Bell shows that all local hidden variable theories must satisfy Bell's inequality
1964 Val Fitch and James Cronin observe CP violation by the weak force in the decay of K mesons
1967 Steven Weinberg puts forth his electroweak model of leptons
1969 John Clauser, Michael Horne, Abner Shimony and Richard Holt propose a polarization correlation test of Bell's inequality
1970 Sheldon Glashow, John Iliopoulos, and Luciano Maiani propose the charm quark
1971 Gerard 't Hooft shows that the Glashow-Salam-Weinberg electroweak model can be renormalized
1972 Stuart Freedman and John Clauser perform the first polarization correlation test of Bell's inequality
1973 David Politzer and Frank Anthony Wilczek propose the asymptotic freedom of quarks
1974 Burton Richter and Samuel Ting discover the J/ψ particle implying the existence of the charm quark
1974 Robert J. Buenker and Sigrid D. Peyerimhoff introduce the multireference configuration interaction method.
1975 Martin Perl discovers the tau lepton
1977 Steve Herb finds the upsilon resonance implying the existence of the beauty/bottom quark
1982 Alain Aspect, J. Dalibard, and G. Roger perform a polarization correlation test of Bell's inequality that rules out conspiratorial polarizer communication
1983 Carlo Rubbia, Simon van der Meer, and the CERN UA-1 collaboration find the W and Z intermediate vector bosons
1989 The Z intermediate vector boson resonance width indicates three quark-lepton generations
1994 The CERN LEAR Crystal Barrel Experiment justifies the existence of glueballs (exotic meson).
1995 The D0 and CDF experiments at the Fermilab Tevatron discover the top quark.
1998 Super-Kamiokande (Japan) observes evidence for neutrino oscillations, implying that at least one neutrino has mass.
1999 Ahmed Zewail wins the Nobel prize in chemistry for his work on femtochemistry for atoms and molecules.
2001 The Sudbury Neutrino Observatory (Canada) confirms the existence of neutrino oscillations.
2005 At the RHIC accelerator of Brookhaven National Laboratory they have created a quark–gluon liquid of very low viscosity, perhaps the quark–gluon plasma
2010 The Large Hadron Collider at CERN begins operation with the primary goal of searching for the Higgs boson.
2012 CERN announces the discovery of a new particle with properties consistent with the Higgs boson of the Standard Model after experiments at the Large Hadron Collider.

Timeline of particle physics

19th century

• 1815 – William Prout hypothesizes that all matter is built up from hydrogen, adumbrating the proton;
• 1838 – Richard Laming hypothesized a subatomic particle carrying electric charge;
• 1858 – Julius Plücker produced cathode rays;
• 1874 – George Johnstone Stoney hypothesizes a minimum unit of electric charge. In 1891, he coins the word electron for it;
• 1886 – Eugene Goldstein produced anode rays;
• 1897 – J. J. Thomson discovered the electron;
• 1899 – Ernest Rutherford discovered the alpha and beta particles emitted by uranium;
• 1900 – Paul Villard discovered the gamma ray in uranium decay.

20th century

• 1905 – Albert Einstein hypothesized the photon to explain the photoelectric effect.
• 1911 – Hans Geiger, Ernest Marsden and Ernest Rutherford discovered the nucleus of an atom;
• 1919 – Ernest Rutherford discovered the proton;
• 1928 – Paul Dirac postulated the existence of positrons as a consequence of the Dirac equation;
• 1930 – Wolfgang Pauli postulated the neutrino to explain the energy spectrum of beta decays;
• 1932 – James Chadwick discovered the neutron;
• 1932 – Carl D. Anderson discovered the positron;
• 1935 – Hideki Yukawa predicted the existence of mesons as the carrier particles of the strong nuclear force;
• 1936 – Carl D. Anderson discovered the muon while he studied cosmic radiation;
• 1947 – George Dixon Rochester and Clifford Charles Butler discovered the kaon, the first strange particle;
• 1947 – Cecil Powell, César Lattes and Giuseppe Occhialini discovered the pion;
• 1955 – Owen Chamberlain, Emilio Segrè, Clyde Wiegand, and Thomas Ypsilantis discovered the antiproton;
• 1956 – Clyde Cowan and Frederick Reines discovered the (electron) neutrino;
• 1957 – Bruno Pontecorvo postulated the flavor oscillation;
• 1962 – Leon M. Lederman, Melvin Schwartz and Jack Steinberger discovered the muon neutrino;
• 1967 – Bruno Pontecorvo postulated neutrino oscillation;
• 1974 – Burton Richter and Samuel Ting discovered the J/ψ particle composed of charm quarks;
• 1977 – Upsilon particle discovered at Fermilab, demonstrating the existence of the bottom quark;
• 1977 – Martin Lewis Perl discovered the tau lepton after a series of experiments;
• 1979 – Gluon observed indirectly in three-jet events at DESY;
• 1983 – Carlo Rubbia and Simon van der Meer discovered the W and Z bosons;
21st century

- 2012 – Higgs boson-like particle discovered at CERN's Large Hadron Collider (LHC).

Timeline of quantum computing

1960s

- 1960
  - Stephen Wiesner invents conjugate coding.

1970s

- 1970
  - James Park articulates the no-cloning theorem
- 1973
  - Alexander Holevo publishes a paper showing that \( n \) qubits can carry more than \( n \) classical bits of information, but at most \( n \) classical bits are accessible (a result known as "Holevo's theorem" or "Holevo's bound").
  - Charles H. Bennett shows that computation can be done reversibly.
- 1975
  - R. P. Poplavskii publishes "Thermodynamical models of information processing" (in Russian) which showed the computational infeasibility of simulating quantum systems on classical computers, due to the superposition principle.
- 1976
  - Polish mathematical physicist Roman Stanislaw Ingarden publishes a seminal paper entitled "Quantum Information Theory" in Reports on Mathematical Physics, vol. 10, 43–72, 1976. (The paper was submitted in 1975.) It is one of the first attempts at creating a quantum information theory, showing that Shannon information theory cannot directly be generalized to the quantum case, but rather that it is possible to construct a quantum information theory, which is a generalization of Shannon's theory, within the formalism of a generalized quantum mechanics of open systems and a generalized concept of observables (the so-called semi-observables).

1980s

- 1980
  - Paul Benioff describes the first quantum mechanical model of a computer. In this work, Benioff showed that a computer could operate under the laws of quantum mechanics by describing a Schrödinger equation description of Turing machines, laying a foundation for further work in quantum computing. The paper was submitted in June 1979 and published in April 1980.
Yuri Manin briefly motivates the idea of quantum computing.
Tommaso Toffoli introduces the reversible Toffoli gate, which, together with the NOT and XOR gates provides a universal set for reversible classical computation.

1981
At the First Conference on the Physics of Computation, held at MIT in May, Paul Benioff and Richard Feynman give talks on quantum computing. Benioff's built on his earlier 1980 work showing that a computer can operate under the laws of quantum mechanics. The talk was titled “Quantum mechanical Hamiltonian models of discrete processes that erase their own histories: application to Turing machines”. In Feynman's talk, he observed that it appeared to be impossible to efficiently simulate an evolution of a quantum system on a classical computer, and he proposed a basic model for a quantum computer.

1982
Paul Benioff further develops his original model of a quantum mechanical Turing machine.
William Wootters and Wojciech Zurek, and independently Dennis Dieks rediscover the no-cloning theorem.

1984
Charles Bennett and Gilles Brassard employ Wiesner's conjugate coding for distribution of cryptographic keys.

1985
David Deutsch, at the University of Oxford, describes the first universal quantum computer. Just as a Universal Turing machine can simulate any other Turing machine efficiently (Church-Turing thesis), so the universal quantum computer is able to simulate any other quantum computer with at most a polynomial slowdown.

1988
Yoshihisa Yamamoto (scientist) and K. Igeta propose the first physical realization of a quantum computer, including Feynman's CNOT gate. Their approach uses atoms and photons and is the progenitor of modern quantum computing and networking protocols using photons to transmit qubits and atoms to perform two-qubit operations.
Gerard J. Milburn proposes a quantum-optical realization of a Fredkin gate.

1989
Bikas K. Chakrabarti & collaborators from Saha Institute of Nuclear Physics, Kolkata, propose the idea that quantum fluctuations could help explore rough energy landscapes by escaping from local minima of glassy systems having tall but thin barriers by tunneling (instead of climbing over using thermal excitations), suggesting the effectiveness of quantum annealing over classical simulated annealing.

1990s

1991
Artur Ekert at the University of Oxford, expands on the original proposal by David Deutsch, for entanglement-based secure communication.

1992
David Deutsch and Richard Jozsa propose a computational problem that can be solved efficiently with the determinist Deutsch–Jozsa algorithm on a quantum computer, but for which no deterministic classical algorithm is possible. This was perhaps the earliest result in the computational complexity of quantum computers, proving that they were capable of performing some well-defined computational task more efficiently than any classical computer.

1993
Dan Simon, at Université de Montréal, invents an oracle problem for which a quantum computer would be exponentially faster than a conventional computer. This algorithm introduces the main ideas which were then developed in Peter Shor's factorization algorithm.
1994
- Peter Shor, at AT&T's Bell Labs in New Jersey, discovers an important algorithm. It allows a quantum computer to factor large integers quickly. It solves both the factoring problem and the discrete log problem. Shor's algorithm can theoretically break many of the cryptosystems in use today. Its invention sparked a tremendous interest in quantum computers.
- First United States Government workshop on quantum computing is organized by NIST in Gaithersburg, Maryland, in autumn.
- Isaac Chuang and Yoshihisa Yamamoto propose a quantum-optical realization of a quantum computer to implement Deutsch's algorithm. Their work introduces dual-rail encoding for photonic qubits.
- In December, Ignacio Cirac, at University of Castilla-La Mancha at Ciudad Real, and Peter Zoller at the University of Innsbruck propose an experimental realization of the controlled-NOT gate with cold trapped ions.

1995
- The first United States Department of Defense workshop on quantum computing and quantum cryptography is organized by United States Army physicists Charles M. Bowden, Jonathan P. Dowling, and Henry O. Everitt; it takes place in February at the University of Arizona in Tucson.
- Peter Shor proposes the first schemes for quantum error correction.
- Christopher Monroe and David Wineland at NIST (Boulder, Colorado) experimentally realize the first quantum logic gate—the controlled-NOT gate—with trapped ions, following the Cirac-Zoller proposal.

1996
- Lov Grover, at Bell Labs, invents the quantum database search algorithm. The quadratic speedup is not as dramatic as the speedup for factoring, discrete logs, or physics simulations. However, the algorithm can be applied to a much wider variety of problems. Any problem that has to be solved by random, brute-force search, can take advantage of this quadratic speedup (in the number of search queries).
- The United States Government, particularly in a joint partnership of the Army Research Office (now part of the Army Research Laboratory) and the National Security Agency, issues the first public call for research proposals in quantum information processing.
- Andrew Steane designs Steane codes for error correction.
- David P. DiVincenzo, from IBM, proposes a list of minimal requirements for creating a quantum computer.

1997
- David Cory, Amr Fahmy and Timothy Havel, and at the same time Neil Gershenfeld and Isaac L. Chuang at MIT publish the first papers realizing gates for quantum computers based on bulk nuclear spin resonance, or thermal ensembles. The technology is based on a nuclear magnetic resonance (NMR) machine, which is similar to the medical magnetic resonance imaging machine.
- Alexei Kitaev describes the principles of topological quantum computation as a method for combating decoherence.
- Daniel Loss and David P. DiVincenzo propose the Loss-DiVincenzo quantum computer, using as qubits the intrinsic spin-1/2 degree of freedom of individual electrons confined to quantum dots.

1998
- First experimental demonstration of a quantum algorithm. A working 2-qubit NMR quantum computer is used to solve Deutsch's problem by Jonathan A. Jones and Michele Mosca at Oxford University and shortly after by Isaac L. Chuang at IBM's Almaden Research Center and Mark Kubinec and the University of California, Berkeley together with coworkers at Stanford University and MIT.
- First working 3-qubit NMR computer.
Bruce Kane proposes a silicon based nuclear spin quantum computer, using nuclear spins of individual phosphorus atoms in silicon as the qubits and donor electrons to mediate the coupling between qubits.

First execution of Grover's algorithm on an NMR computer.

Hidetoshi Nishimori & colleagues from Tokyo Institute of Technology showed that quantum annealing algorithm can perform better than classical simulated annealing.

Daniel Gottesman and Emanuel Knill independently prove that a certain subclass of quantum computations can be efficiently emulated with classical resources (Gottesman–Knill theorem).

1999

Samuel L. Braunstein and collaborators show that none of the bulk NMR experiments performed to date contained any entanglement, the quantum states being too strongly mixed. This is seen as evidence that NMR computers would likely not yield a benefit over classical computers. It remains an open question, however, whether entanglement is necessary for quantum computational speedup.

Gabriel Aeppli, Thomas Felix Rosenbaum and colleagues demonstrate experimentally the basic concepts of quantum annealing in a condensed matter system.

Yasunobu Nakamura and Jaw-Shen Tsai demonstrate that a superconducting circuit can be used as a qubit. This leads to a global effort to develop quantum computers using superconducting circuits, culminating in Google's demonstration of quantum supremacy using this technology in 2019.

2000

Arun K. Pati and Samuel L. Braunstein proved the quantum no-deleting theorem. This is dual to the no-cloning theorem which shows that one cannot delete a copy of an unknown qubit. Together with the stronger no-cloning theorem, the no-deleting theorem has important implication, i.e., quantum information can neither be created nor be destroyed.

First working 5-qubit NMR computer demonstrated at the Technical University of Munich.

First execution of order finding (part of Shor's algorithm) at IBM's Almaden Research Center and Stanford University.

First working 7-qubit NMR computer demonstrated at the Los Alamos National Laboratory.

The standard textbook, Quantum Computation and Quantum Information, by Michael Nielsen and Isaac Chuang is published.

2001

First execution of Shor's algorithm at IBM's Almaden Research Center and Stanford University. The number 15 was factored using $10^{18}$ identical molecules, each containing seven active nuclear spins.

Noah Linden and Sandu Popescu proved that the presence of entanglement is a necessary condition for a large class of quantum protocols. This, coupled with Braunstein's result (see 1999 above), called the validity of NMR quantum computation into question.

Emanuel Knill, Raymond Laflamme, and Gerard Milburn show that optical quantum computing is possible with single photon sources, linear optical elements, and single photon detectors, launching the field of linear optical quantum computing.

Robert Raussendorf and Hans Jürgen Briegel propose measurement-based quantum computation.

2002

The Quantum Information Science and Technology Roadmapping Project, involving some of the main participants in the field, laid out the Quantum computation roadmap.

The Institute for Quantum Computing was established at the University of Waterloo in Waterloo, Ontario by Mike Lazaridis, Raymond Laflamme and Michele Mosca.
2003

- Implementation of the Deutsch–Jozsa algorithm on an ion-trap quantum computer at the University of Innsbruck
  - Todd D. Pittman and collaborators at Johns Hopkins University, Applied Physics Laboratory and independently Jeremy L. O'Brien and collaborators at the University of Queensland, demonstrate quantum controlled-not gates using only linear optical elements.
  - First implementation of a CNOT quantum gate according to the Cirac–Zoller proposal by a group at the University of Innsbruck led by Rainer Blatt.
  - DARPA Quantum Network becomes fully operational on October 23, 2003.
  - The Institute for Quantum Optics and Quantum Information (IQOQI) was established in Innsbruck and Vienna, Austria, by the founding directors Rainer Blatt, Hans Jürgen Briegel, Rudolf Grimm, Anton Zeilinger and Peter Zoller.

2004

- First working pure state NMR quantum computer (based on parahydrogen) demonstrated at Oxford University and University of York.
  - Physicists at the University of Innsbruck show deterministic quantum-state teleportation between a pair of trapped calcium ions.
  - First five-photon entanglement demonstrated by Jian-Wei Pan's group at the University of Science and Technology of China, the minimal number of qubits required for universal quantum error correction.

2005

- University of Illinois at Urbana–Champaign scientists demonstrate quantum entanglement of multiple characteristics, potentially allowing multiple qubits per particle.
- Two teams of physicists measured the capacitance of a Josephson junction for the first time. The methods could be used to measure the state of quantum bits in a quantum computer without disturbing the state.
- In December, the first quantum byte, or qubyte, is announced to have been created by scientists at the Institute for Quantum Optics and Quantum Information and the University of Innsbruck in Austria.
- Harvard University and Georgia Institute of Technology researchers succeeded in transferring quantum information between "quantum memories" – from atoms to photons and back again.

2006

- Materials Science Department of Oxford University, cage a qubit in a "buckyball" (a molecule of buckminsterfullerene), and demonstrated quantum "bang-bang" error correction.
- Researchers from the University of Illinois at Urbana–Champaign use the Zeno Effect, repeatedly measuring the properties of a photon to gradually change it without actually allowing the photon to reach the program, to search a database without actually "running" the quantum computer.
- Vlatko Vedral of the University of Leeds and colleagues at the universities of Porto and Vienna found that the photons in ordinary laser light can be quantum mechanically entangled with the vibrations of a macroscopic mirror.
- Samuel L. Braunstein at the University of York along with the University of Tokyo and the Japan Science and Technology Agency gave the first experimental demonstration of quantum teleporting.
- Professors at the University of Sheffield develop a means to efficiently produce and manipulate individual photons at high efficiency at room temperature.
- New error checking method theorized for Josephson junction computers.
• First 12 qubit quantum computer benchmarked by researchers at the Institute for Quantum Computing and the Perimeter Institute for Theoretical Physics in Waterloo, as well as MIT, Cambridge.
• Two dimensional ion trap developed for quantum computing.
• Seven atoms placed in stable line, a step on the way to constructing a quantum gate, at the University of Bonn.
• A team at Delft University of Technology in the Netherlands created a device that can manipulate the "up" or "down" spin-states of electrons on quantum dots.
• University of Arkansas develops quantum dot molecules.
• Spinning new theory on particle spin brings science closer to quantum computing.
• University of Copenhagen develops quantum teleportation between photons and atoms.
• University of Camerino scientists develop theory of macroscopic object entanglement, which has implications for the development of quantum repeaters.
• Tai-Chang Chiang, at Illinois at Urbana–Champaign, finds that quantum coherence can be maintained in mixed-material systems.
• Cristophe Boehme, University of Utah, demonstrates the feasibility of reading spin-data on a silicon-phosphorus quantum computer.

2007

• Subwavelength waveguide developed for light.
• Single photon emitter for optical fibers developed.
• Six-photon one-way quantum computer is created in lab.
• New material proposed for quantum computing.
• Single atom single photon server devised.
• First use of Deutsch's Algorithm in a cluster state quantum computer.
• University of Cambridge develops electron quantum pump.
• Superior method of qubit coupling developed.
• Successful demonstration of controllably coupled qubits.
• Breakthrough in applying spin-based electronics to silicon.
• Scientists demonstrate quantum state exchange between light and matter.
• Diamond quantum register developed.
• Controlled-NOT quantum gates on a pair of superconducting quantum bits realized.
• Scientists contain, study hundreds of individual atoms in 3D array.
• Nitrogen in buckyball molecule used in quantum computing.
• Large number of electrons quantum coupled.
• Spin-orbit interaction of electrons measured.
• Atoms quantum manipulated in laser light.
• Light pulses used to control electron spins.
• Quantum effects demonstrated across tens of nanometers.
• Light pulses used to accelerate quantum computing development.
• Quantum RAM blueprint unveiled.
• Model of quantum transistor developed.
• Long distance entanglement demonstrated.
• Photonic quantum computing used to factor number by two independent labs.
• Quantum bus developed by two independent labs.
• Superconducting quantum cable developed.
• Transmission of qubits demonstrated.
• Superior qubit material devised.
• Single electron qubit memory.
• Bose-Einstein condensate quantum memory developed.
• D-Wave Systems demonstrates use of a 28-qubit quantum annealing computer.
• New cryonic method reduces decoherence and increases interaction distance, and thus quantum computing speed.
• Photonic quantum computer demonstrated.
• Graphene quantum dot spin qubits proposed.

2008

• Graphene quantum dot qubits
• Quantum bit stored
• 3D qubit-qutrit entanglement demonstrated
• Analog quantum computing devised
• Control of quantum tunneling
• Entangled memory developed
• Superior NOT gate developed
• Qutrits developed
• Quantum logic gate in optical fiber
• Superior quantum Hall Effect discovered
• Enduring spin states in quantum dots
• Molecular magnets proposed for quantum RAM
• Quasiparticles offer hope of stable quantum computer
• Image storage may have better storage of qubits
• Quantum entangled images
• Quantum state intentionally altered in molecule
• Electron position controlled in silicon circuit
• Superconducting electronic circuit pumps microwave photons
• Amplitude spectroscopy developed
• Superior quantum computer test developed
• Optical frequency comb devised
• Quantum Darwinism supported
• Hybrid qubit memory developed
• Qubit stored for over 1 second in atomic nucleus
• Faster electron spin qubit switching and reading developed
• Possible non-entanglement quantum computing
• D-Wave Systems claims to have produced a 128 qubit computer chip, though this claim has yet to be verified.
2009

- Carbon 12 purified for longer coherence times
- Lifetime of qubits extended to hundreds of milliseconds
- Quantum control of photons
- Quantum entanglement demonstrated over 240 micrometres
- Qubit lifetime extended by factor of 1000
- First electronic quantum processor created
- Six-photon graph state entanglement used to simulate the fractional statistics of anyons living in artificial spin-lattice models
- Single molecule optical transistor
- NIST reads, writes individual qubits
- NIST demonstrates multiple computing operations on qubits
- First large-scale topological cluster state quantum architecture developed for atom-optics
- A combination of all of the fundamental elements required to perform scalable quantum computing through the use of qubits stored in the internal states of trapped atomic ions shown
- Researchers at University of Bristol demonstrate Shor's algorithm on a silicon photonic chip
- Quantum Computing with an Electron Spin Ensemble
- Scalable flux qubit demonstrated
- Photon machine gun developed for quantum computing
- Quantum algorithm developed for differential equation systems
- First universal programmable quantum computer unveiled
- Scientists electrically control quantum states of electrons
- Google collaborates with D-Wave Systems on image search technology using quantum computing
- A method for synchronizing the properties of multiple coupled CJJ rf-SQUID flux qubits with a small spread of device parameters due to fabrication variations was demonstrated
- Realization of Universal Ion Trap Quantum Computation with Decoherence Free Qubits

2010s

2010

- Ion trapped in optical trap
- Optical quantum computer with three qubits calculated the energy spectrum of molecular hydrogen to high precision
- First germanium laser brings us closer to optical computers
- Single electron qubit developed
- Quantum state in macroscopic object
- New quantum computer cooling method developed
- Racetrack ion trap developed
- Evidence for a Moore-Read state in the $u=5/2$ quantum Hall plateau, which would be suitable for topological quantum computation
- Quantum interface between a single photon and a single atom demonstrated
- LED quantum entanglement demonstrated
- Multiplexed design speeds up transmission of quantum information through a quantum communications channel
- Two photon optical chip
- Microfabricated planar ion traps
- Qubits manipulated electrically, not magnetically

2011

- Entanglement in a solid-state spin ensemble
- NOON photons in superconducting quantum integrated circuit
- Quantum antenna
- Multimode quantum interference
- Magnetic Resonance applied to quantum computing
- Quantum pen
- Atomic "Racing Dual"
- 14 qubit register
- D-Wave claims to have developed quantum annealing and introduces their product called D-Wave One. The company claims this is the first commercially available quantum computer
- Repetitive error correction demonstrated in a quantum processor
- Diamond quantum computer memory demonstrated
- Qmodes developed
- Decoherence suppressed
- Simplification of controlled operations
- Ions entangled using microwaves
- Practical error rates achieved
- Quantum computer employing Von Neumann architecture
- Quantum spin Hall topological insulator
- Two Diamonds Linked by Quantum Entanglement could help develop photonic processors

2012

- D-Wave claims a quantum computation using 84 qubits.
- Physicists create a working transistor from a single atom
- A method for manipulating the charge of nitrogen vacancy-centres in diamond
- Reported creation of a 300 qubit/particle quantum simulator.
- Demonstration of topologically protected qubits with an eight-photon entanglement, a robust approach to practical quantum computing
- 1QB Information Technologies (1QBit) founded. World's first dedicated quantum computing software company.
- First design of a quantum repeater system without a need for quantum memories
- Decoherence suppressed for 2 seconds at room temperature by manipulating Carbon-13 atoms with lasers.
- Theory of Bell-based randomness expansion with reduced assumption of measurement independence.
- New low overhead method for fault-tolerant quantum logic developed, called lattice surgery
2013

- Coherence time of 39 minutes at room temperature (and 3 hours at cryogenic temperatures) demonstrated for an ensemble of impurity-spin qubits in isotopically purified silicon.
- Extension of time for qubit maintained in superimposed state for ten times longer than what has ever been achieved before
- First resource analysis of a large-scale quantum algorithm using explicit fault-tolerant, error-correction protocols was developed for factoring

2014

- Documents leaked by Edward Snowden confirm the Penetrating Hard Targets project, by which the National Security Agency seeks to develop a quantum computing capability for cryptography purposes.
- Researchers in Japan and Austria publish the first large-scale quantum computing architecture for a diamond based system
- Scientists at the University of Innsbruck do quantum computations on a topologically encoded qubit which is encoded in entangled states distributed over seven trapped-ion qubits
- Scientists transfer data by quantum teleportation over a distance of 10 feet (3.048 meters) with zero percent error rate, a vital step towards a quantum Internet.
- Nike Dattani & Nathan Bryans break the record for largest number factored on a quantum device: 56153 (previous record was 143).

2015

- Optically addressable nuclear spins in a solid with a six-hour coherence time.
- Quantum information encoded by simple electrical pulses.
- Quantum error detection code using a square lattice of four superconducting qubits.
- D-Wave Systems Inc. announced on June 22 that it had broken the 1000 qubit barrier.
- Two qubit silicon logic gate successfully developed.
- Quantum computer, along with quantum superposition and entanglement, emulated by a classical analog computer, with the result that the fully classical system behaves like a true quantum computer.

2016

- Physicists led by Rainer Blatt joined forces with scientists at MIT, led by Isaac Chuang, to efficiently implement Shor's algorithm in an ion-trap based quantum computer.
- IBM releases the Quantum Experience, an online interface to their superconducting systems. The system is immediately used to publish new protocols in quantum information processing
- Google, using an array of 9 superconducting qubits developed by the Martinis group and UCSB, simulates a hydrogen molecule.
- Scientists in Japan and Australia invent the quantum version of a Sneakernet communications system

2017

- D-Wave Systems Inc. announces general commercial availability of the D-Wave 2000Q quantum annealer, which it claims has 2000 qubits.
- Blueprint for a microwave trapped ion quantum computer published.
• IBM unveils 17-qubit quantum computer—and a better way of benchmarking it.
• Scientists build a microchip that generates two entangled qudits each with 10 states, for 100 dimensions total.
• Microsoft reveals Q Sharp, a quantum programming language integrated with Visual Studio. Programs can be executed locally on a 32-qubit simulator, or a 40-qubit simulator on Azure.
• Intel confirms development of a 17-qubit superconducting test chip.
• IBM reveals a working 50-qubit quantum computer that can maintain its quantum state for 90 microseconds.

2018

• MIT scientists report the discovery of a new triple-photon form of light.
• Oxford researchers successfully used a trapped-ion technique where they place two charged atoms in a state of quantum entanglement, to speed up logic gates by a factor of 20 to 60 times as compared with the previous best gates, translated to 1.6 microseconds long, with 99.8% precision.
• QuTech successfully tests silicon-based 2-spin-qubit processor.
• Google announces the creation of a 72-qubit quantum chip, called "Bristlecone", achieving a new record.
• Intel begins testing silicon-based spin-qubit processor, manufactured in the company's D1D Fab in Oregon.
• Intel confirms development of a 49-qubit superconducting test chip, called "Tangle Lake".
• Japanese researchers demonstrate universal holonomic quantum gates.
• Integrated photonic platform for quantum information with continuous variables.
• On December 17, 2018, the company IonQ introduced the first commercial trapped-ion quantum computer, with a program length of over 60 two-qubit gates, 11 fully connected qubits, 55 addressable pairs, one-qubit gate error <0.03% and two-qubit gate error <1.0%
• On December 21, 2018, the National Quantum Initiative Act was signed into law by President Donald Trump, establishing the goals and priorities for a 10-year plan to accelerate the development of quantum information science and technology applications in the United States.

2019

• IBM unveils its first commercial quantum computer, the IBM Q System One, designed by UK-based Map Project Office and Universal Design Studio and manufactured by Goppion.
• Nike Dattani and co-workers de-code D-Wave's Pegasus architecture and make its description open to the public.
• Austrian physicists demonstrate self-verifying, hybrid, variational quantum simulation of lattice models in condensed matter and high-energy physics using a feedback loop between a classical computer and a quantum co-processor.
• A paper by Google's quantum computer research team was briefly available in late September 2019, claiming the project has reached quantum supremacy.
• IBM reveals its biggest yet quantum computer, consisting of 53 qubits. The system goes online in October 2019.

2020

• UNSW Sydney develops a way of producing 'hot qubits' – quantum devices that operate at 1.5 Kelvin.
Griffith university, UNSW and UTS in partnership with 7 USA universities develop Noise cancelling for quantum bits via machine learning, taking quantum noise in a quantum chip down to 0%.

UNSW performs electric nuclear resonance to control single atoms in electronic devices.

Bob Coecke (Oxford university) explains why NLP is quantum-native. A graphical representation of how the meanings of the words are combined to build the meaning of a sentence as a whole, was created.

Tokyo university and Australian scientists create and successfully test a solution to the quantum wiring problem, creating a 2d structure for qubits. Such structure can be built using existing integrated circuit technology and has a considerably lower cross-talk.

Timeline of thermodynamics

Before 1800

- 1650 – Otto von Guericke builds the first vacuum pump
- 1660 – Robert Boyle experimentally discovers Boyle's Law, relating the pressure and volume of a gas (published 1662)
- 1665 – Robert Hooke stated: "Heat being nothing else but a very brisk and vehement agitation of the parts of a body."
- 1669 – J. J. Becher puts forward a theory of combustion involving combustible earth (Latin terra pinguis).
- 1676–1689 – Gottfried Leibniz develops the concept of vis viva, a limited version of the conservation of energy
- 1679 – Denis Papin designed a steam digester which inspired the development of the piston-and-cylinder steam engine.
- 1694–1734 – Georg Ernst Stahl names Becher's combustible earth as phlogiston and develops the theory
- 1698 – Thomas Savery patents an early steam engine
- 1702 – Guillaume Amontons introduces the concept of absolute zero, based on observations of gases
- 1738 – Daniel Bernoulli publishes Hydrodynamica, initiating the kinetic theory
- 1749 – Émilie du Châtelet, in her French translation and commentary on Newton's Philosophiae Naturalis Principia Mathematica, derives the conservation of energy from the first principles of Newtonian mechanics.
- 1761 – Joseph Black discovers that ice absorbs heat without changing its temperature when melting
- 1772 – Black's student Daniel Rutherford discovers nitrogen, which he calls phlogisticated air, and together they explain the results in terms of the phlogiston theory
• 1776 – John Smeaton publishes a paper on experiments related to power, work, momentum, and kinetic energy, supporting the conservation of energy
• 1777 – Carl Wilhelm Scheele distinguishes heat transfer by thermal radiation from that by convection and conduction
• 1783 – Antoine Lavoisier discovers oxygen and develops an explanation for combustion; in his paper "Réflexions sur le phlogistique", he deprecates the phlogiston theory and proposes a caloric theory
• 1784 – Jan Ingenhousz describes Brownian motion of charcoal particles on water
• 1791 – Pierre Prévost shows that all bodies radiate heat, no matter how hot or cold they are
• 1798 – Count Rumford (Benjamin Thompson) performs measurements of the frictional heat generated in boring cannons and develops the idea that heat is a form of kinetic energy; his measurements are inconsistent with caloric theory, but are also sufficiently imprecise as to leave room for doubt.

1800–1847

• 1802 – Joseph Louis Gay-Lussac publishes Charles's law, discovered (but unpublished) by Jacques Charles around 1787; this shows the dependency between temperature and volume. Gay-Lussac also formulates the law relating temperature with pressure (the pressure law, or Gay-Lussac's law)
• 1804 – Sir John Leslie observes that a matte black surface radiates heat more effectively than a polished surface, suggesting the importance of black-body radiation
• 1805 – William Hyde Wollaston defends the conservation of energy in *On the Force of Percussion*
• 1808 – John Dalton defends caloric theory in *A New System of Chemistry* and describes how it combines with matter, especially gases; he proposes that the heat capacity of gases varies inversely with atomic weight
• 1810 – Sir John Leslie freezes water to ice artificially
• 1813 – Peter Ewart supports the idea of the conservation of energy in his paper *On the measure of moving force*; the paper strongly influences Dalton and his pupil, James Joule
• 1819 – Pierre Louis Dulong and Alexis Thérèse Petit give the Dulong-Petit law for the specific heat capacity of a crystal
• 1820 – John Herapath develops some ideas in the kinetic theory of gases but mistakenly associates temperature with molecular momentum rather than kinetic energy; his work receives little attention other than from Joule
• 1822 – Joseph Fourier formally introduces the use of dimensions for physical quantities in his *Théorie Analytique de la Chaleur*
• 1822 – Marc Seguin writes to John Herschel supporting the conservation of energy and kinetic theory
• 1824 – Sadi Carnot analyzes the efficiency of steam engines using caloric theory; he develops the notion of a reversible process and, in postulating that no such thing exists in nature, lays the foundation for the second law of thermodynamics, and initiating the science of thermodynamics.

• 1827 – Robert Brown discovers the Brownian motion of pollen and dye particles in water.

• 1831 – Macedonio Melloni demonstrates that black-body radiation can be reflected, refracted, and polarised in the same way as light.

• 1834 – Émile Clapeyron popularises Carnot's work through a graphical and analytic formulation. He also combined Boyle's Law, Charles's Law, and Gay-Lussac's Law to produce a Combined Gas Law. \( PV/T = k \)

• 1841 – Julius Robert von Mayer, an amateur scientist, writes a paper on the conservation of energy, but his lack of academic training leads to its rejection.

• 1842 – Mayer makes a connection between work, heat, and the human metabolism based on his observations of blood made while a ship's surgeon; he calculates the mechanical equivalent of heat.

• 1842 – William Robert Grove demonstrates the thermal dissociation of molecules into their constituent atoms, by showing that steam can be disassociated into oxygen and hydrogen, and the process reversed.

• 1843 – John James Waterston fully expounds the kinetic theory of gases, but is ridiculed and ignored.

• 1843 – James Joule experimentally finds the mechanical equivalent of heat.

• 1845 – Henri Victor Regnault added Avogadro's Law to the Combined Gas Law to produce the Ideal Gas Law. \( PV = nRT \)

• 1846 – Karl-Hermann Knoblauch publishes *De calore radiante disquisitiones experimentis quibusdam novis illustratae*.

• 1846 – Grove publishes an account of the general theory of the conservation of energy in *On The Correlation of Physical Forces*.

• 1847 – Hermann von Helmholtz publishes a definitive statement of the conservation of energy, the first law of thermodynamics.

1848–1899

• 1848 – William Thomson extends the concept of absolute zero from gases to all substances.

• 1849 – William John Macquorn Rankine calculates the correct relationship between saturated vapour pressure and temperature using his hypothesis of molecular vortices.

• 1850 – Rankine uses his vortex theory to establish accurate relationships between the temperature, pressure, and density of gases, and expressions for the latent heat of evaporation of a liquid; he accurately predicts the surprising fact that the apparent specific heat of saturated steam will be negative.
• 1850 – Rudolf Clausius gives the first clear joint statement of the first and second law of thermodynamics, abandoning the caloric theory, but preserving Carnot's principle
• 1851 – Thomson gives an alternative statement of the second law
• 1852 – Joule and Thomson demonstrate that a rapidly expanding gas cools, later named the Joule–Thomson effect or Joule–Kelvin effect
• 1854 – Helmholtz puts forward the idea of the heat death of the universe
• 1854 – Clausius establishes the importance of $dQ/T$ (Clausius's theorem), but does not yet name the quantity
• 1854 – Rankine introduces his thermodynamic function, later identified as entropy
• 1856 – August Krönig publishes an account of the kinetic theory of gases, probably after reading Waterston's work
• 1857 – Clausius gives a modern and compelling account of the kinetic theory of gases in his *On the nature of motion called heat*
• 1859 – James Clerk Maxwell discovers the distribution law of molecular velocities
• 1859 – Gustav Kirchhoff shows that energy emission from a black body is a function of only temperature and frequency
• 1862 – "Disgregation", a precursor of entropy, was defined in 1862 by Clausius as the magnitude of the degree of separation of molecules of a body
• 1865 – Clausius introduces the modern macroscopic concept of entropy
• 1865 – Josef Loschmidt applies Maxwell's theory to estimate the number-density of molecules in gases, given observed gas viscosities.
• 1867 – Maxwell asks whether Maxwell's demon could reverse irreversible processes
• 1870 – Clausius proves the scalar virial theorem
• 1872 – Ludwig Boltzmann states the Boltzmann equation for the temporal development of distribution functions in phase space, and publishes his H-theorem
• 1873 - Johannes Diderik van der Waals formulates his equation of state
• 1874 – Thomson formally states the second law of thermodynamics
• 1876 – Josiah Willard Gibbs publishes the first of two papers (the second appears in 1878) which discuss phase equilibria, statistical ensembles, the free energy as the driving force behind chemical reactions, and chemical thermodynamics in general.
• 1876 – Loschmidt criticises Boltzmann's H theorem as being incompatible with microscopic reversibility (Loschmidt's paradox).
• 1877 – Boltzmann states the relationship between entropy and probability
• 1879 – Jožef Stefan observes that the total radiant flux from a blackbody is proportional to the fourth power of its temperature and states the Stefan–Boltzmann law
• 1884 – Boltzmann derives the Stefan–Boltzmann blackbody radiant flux law from thermodynamic considerations
• 1888 – Henri-Louis Le Chatelier states his principle that the response of a chemical system perturbed from equilibrium will be to counteract the perturbation
• 1889 – Walther Nernst relates the voltage of electrochemical cells to their chemical thermodynamics via the Nernst equation
• 1889 – Svante Arrhenius introduces the idea of activation energy for chemical reactions, giving the Arrhenius equation
• 1893 – Wilhelm Wien discovers the displacement law for a blackbody's maximum specific intensity

1900–1944

• 1900 – Max Planck suggests that light may be emitted in discrete frequencies, giving his law of black-body radiation
• 1905 – Albert Einstein argues that the reality of quanta would explain the photoelectric effect
• 1905 – Einstein mathematically analyzes Brownian motion as a result of random molecular motion
• 1906 – Nernst presents a formulation of the third law of thermodynamics
• 1907 – Einstein uses quantum theory to estimate the heat capacity of an Einstein solid
• 1909 – Constantin Carathéodory develops an axiomatic system of thermodynamics
• 1910 – Einstein and Marian Smoluchowski find the Einstein–Smoluchowski formula for the attenuation coefficient due to density fluctuations in a gas
• 1911 – Paul Ehrenfest and Tatjana Ehrenfest–Afanassjewa publish their classical review on the statistical mechanics of Boltzmann, Begriffliche Grundlagen der statistischen Auffassung in der Mechanik
• 1912 – Peter Debye gives an improved heat capacity estimate by allowing low-frequency phonons
• 1916 – Sydney Chapman and David Enskog systematically develop the kinetic theory of gases.
• 1916 – Einstein considers the thermodynamics of atomic spectral lines and predicts stimulated emission
• 1919 – James Jeans discovers that the dynamical constants of motion determine the distribution function for a system of particles
• 1920 – Meghnad Saha states his ionization equation
• 1923 – Debye and Erich Hückel publish a statistical treatment of the dissociation of electrolytes
• 1924 – Satyendra Nath Bose introduces Bose–Einstein statistics, in a paper translated by Einstein
- 1926 – Enrico Fermi and Paul Dirac introduce Fermi–Dirac statistics for fermions
- 1927 – John von Neumann introduces the density matrix representation and establishes quantum statistical mechanics
- 1928 – John B. Johnson discovers Johnson noise in a resistor
- 1928 – Harry Nyquist derives the fluctuation-dissipation theorem, a relationship to explain Johnson noise in a resistor
- 1929 – Lars Onsager derives the Onsager reciprocal relations
- 1938 – Anatoly Vlasov proposes the Vlasov equation for a correct dynamical description of ensembles of particles with collective long range interaction.
- 1939 – Nikolay Krylov and Nikolay Bogolyubov give the first consistent microscopic derivation of the Fokker–Planck equation in the single scheme of classical and quantum mechanics.
- 1942 – Joseph L. Doob states his theorem on Gauss–Markov processes
- 1944 – Lars Onsager gives an analytic solution to the 2-dimensional Ising model, including its phase transition

1945–present

- 1945–1946 – Nikolay Bogoliubov develops a general method for a microscopic derivation of kinetic equations for classical statistical systems using BBGKY hierarchy
- 1947 – Nikolay Bogoliubov and Kirill Gurov extend this method for a microscopic derivation of kinetic equations for quantum statistical systems
- 1948 – Claude Elwood Shannon establishes information theory
- 1957 – Aleksandr Solomonovich Kompaneets derives his Compton scattering Fokker–Planck equation
- 1957 – Ryogo Kubo derives the first of the Green-Kubo relations for linear transport coefficients
- 1957 – Edwin T. Jaynes gives MaxEnt interpretation of thermodynamics from information theory.
- 1960–1965 – Dmitry Zubarev develops the method of non-equilibrium statistical operator, which becomes a classical tool in the statistical theory of non-equilibrium processes
- 1972 – Jacob Bekenstein suggests that black holes have an entropy proportional to their surface area
- 1974 – Stephen Hawking predicts that black holes will radiate particles with a black-body spectrum which can cause black hole evaporation
- 1977 – Ilya Prigogine wins the Nobel prize for his work on dissipative structures in thermodynamic systems far from equilibrium. The importation and dissipation of energy could reverse the 2nd law of thermodynamics
Timeline of electromagnetism and classical optics

Early developments

- 28th century BC — Ancient Egyptian texts describe electric fish. They refer to them as the "Thunderer of the Nile", and described them as the "protectors" of all other fish.
- 6th century BC — Greek philosopher Thales of Miletus observes that rubbing fur on various substances, such as amber, would cause an attraction between the two, which is now known to be caused by static electricity. He noted that rubbing the amber buttons could attract light objects such as hair and that if the amber was rubbed sufficiently a spark would jump.
- 424 BC Aristophanes "lens" is a glass globe filled with water. (Seneca says that it can be used to read letters no matter how small or dim)
- 4th century BC Mo Di first mentions the camera obscura, a pin-hole camera.
- 3rd century BC Euclid is the first to write about reflection and refraction and notes that light travels in straight lines.
- 3rd century BC — The Baghdad Battery is dated from this period. It resembles a galvanic cell and is believed by some to have been used for electroplating, although there is no common consensus on the purpose of these devices nor whether they were, indeed, even electrical in nature.
- 1st century AD — Pliny in his Natural History records the story of a shepherd Magnes who discovered the magnetic properties of some iron stones, "it is said, made this discovery, when, upon taking his herds to pasture, he found that the nails of his shoes and the iron ferrel of his staff adhered to the ground."
- 130 AD. — Claudius Ptolemy (in his work Optics) wrote about the properties of light including: reflection, refraction, and color and tabulated angles of refraction for several media
- 8th century AD — Electric fish are reported by Arabic naturalists and physicians.
- 1088 — Shen Kuo first recognizes magnetic declination.
- 1187 — Alexander Neckham is first in Europe to describe the magnetic compass and its use in navigation.
- 1269 — Pierre de Maricourt describes magnetic poles and remarks on the nonexistence of isolated magnetic poles
- 1305 — Dietrich von Freiberg uses crystalline spheres and flasks filled with water to study the reflection and refraction in raindrops that leads to primary and secondary rainbows
- 14th century AD — Possibly the earliest and nearest approach to the discovery of the identity of lightning, and electricity from any other source, is to be attributed to the Arabs, who before the 15th century had the Arabic word for lightning (raad) applied to the electric ray.
• 1550 — Gerolamo Cardano writes about electricity in *De Subtilitate* distinguishing, perhaps for the first time, between electrical and magnetic forces.

**17th century**

• 1600 — William Gilbert publishes *De Magnete, Magneticisque Corporibus, et de Magno Magnete Tellure* ("On the Magnet and Magnetic bodies, and on that Great Magnet the Earth"), Europe's then current standard on electricity and magnetism. He experimented with and noted the different character of electrical and magnetic forces. In addition to known ancient Greeks' observations of the electrical properties of rubbed amber, he experimented with a needle balanced on a pivot, and found that the needle was non-directionally affected by many materials such as alum, arsenic, hard resin, jet, glass, gum-mastic, mica, rock-salt, sealing wax, slags, sulfur, and precious stones such as amethyst, beryl, diamond, opal, and sapphire. He noted that electrical charge could be stored by covering the body with a non-conducting substance such as silk. He described the method of artificially magnetizing iron. His terrella (little earth), a sphere cut from a lodestone on a metal lathe, modeled the earth as a lodestone (magnetic iron ore) and demonstrated that every lodestone has fixed poles, and how to find them. He considered that gravity was a magnetic force and noted that this mutual force increased with the size or amount of lodestone and attracted iron objects. He experimented with such physical models in an attempt to explain problems in navigation due varying properties of the magnetic compass with respect to their location on the earth, such as magnetic declination and magnetic inclination. His experiments explained the dipping of the needle by the magnetic attraction of the earth, and were used to predict where the vertical dip would be found. Such magnetic inclination was described as early as the 11th century by Shen Kuo in his *Meng Xi Bi Tan* and further investigated in 1581 by retired mariner and compass maker Robert Norman, as described in his pamphlet, *The Newe Attractive*. The gilbert, a unit of magnetomotive force or magnetic scalar potential, was named in his honor.

• 1604 — Johannes Kepler describes how the eye focuses light

• 1604 — Johannes Kepler specifies the laws of the rectilinear propagation of light

• 1608 — first telescopes appear in the Netherlands

• 1611 — Marko Dominis discusses the rainbow in *De Radiis Visus et Lucis*

• 1611 — Johannes Kepler discovers total internal reflection, a small-angle refraction law, and thin lens optics,

• c1620 — the first compound microscopes appear in Europe.

• 1621 — Willebrord van Rijen Snell states his Snell's law of refraction

• 1630 — Cabaeus finds that there are two types of electric charges
• 1637 — René Descartes quantitatively derives the angles at which primary and secondary rainbows are seen with respect to the angle of the Sun's elevation
• 1646 — Sir Thomas Browne first uses the word electricity in his work Pseudodoxia Epidemica.
• 1657 — Pierre de Fermat introduces the principle of least time into optics
• 1660 — Otto von Guericke invents an early electrostatic generator.
• 1663 — Otto von Guericke (brewer and engineer who applied the barometer to weather prediction and invented the air pump, with which he demonstrated the properties of atmospheric pressure associated with a vacuum) constructs a primitive electrostatic generating (or friction) machine via the triboelectric effect, utilizing a continuously rotating sulfur globe that could be rubbed by hand or a piece of cloth. Isaac Newton suggested the use of a glass globe instead of a sulfur one.
• 1665 — Francesco Maria Grimaldi highlights the phenomenon of diffraction
• 1673 — Ignace Pardies provides a wave explanation for refraction of light
• 1675 — Robert Boyle discovers that electric attraction and repulsion can act across a vacuum and do not depend upon the air as a medium. Adds resin to the known list of "electrics."
• 1675 — Isaac Newton delivers his theory of light
• 1676 — Olaus Roemer measures the speed of light by observing Jupiter's moons
• 1678 — Christiaan Huygens states his principle of wavefront sources and demonstrates the refraction and diffraction of light rays.

18th century

• 1704 — Isaac Newton publishes Opticks, a corpuscular theory of light and colour
• 1705 — Francis Hauksbee improves von Guericke's electrostatic generator by using a glass globe and generates the first sparks by approaching his finger to the rubbed globe.
• 1728 — James Bradley discovers the aberration of starlight and uses it to determine that the speed of light is about 283,000 km/s
• 1729 — Stephen Gray and the Reverend Granville Wheler experiment to discover that electrical "virtue", produced by rubbing a glass tube, could be transmitted over an extended distance (nearly 900 ft (about 270 m)) through thin iron wire using silk threads as insulators, to deflect leaves of brass. This has been described as the beginning of electrical communication. This was also the first distinction between the roles of conductors and insulators (names applied by John Desaguliers, mathematician and Royal Society member, who stated that Gray "has made greater variety of electrical experiments than all the philosophers of this and the last age.") Georges-Louis Le Sage built a static electricity telegraph in 1774, based upon the same principles discovered by Gray.
• 1732 — C. F. du Fay shows that all objects, except metals, animals, and liquids, can be electrified by rubbing them and that metals, animals, and liquids could be electrified by means of an electrostatic generator.

• 1734 — Charles François de Cisternay DuFay (inspired by Gray’s work to perform electrical experiments) dispels the effluvia theory by his paper in Volume 38 of the *Philosophical Transactions of the Royal Society*, describing his discovery of the distinction between two kinds of electricity: "resinous", produced by rubbing bodies such as amber, copal, or gum-lac with silk or paper, and "vitreous", by rubbing bodies as glass, rock crystal, or precious stones with hair or wool. He also posited the principle of mutual attraction for unlike forms and the repelling of like forms and that "from this principle one may with ease deduce the explanation of a great number of other phenomena." The terms resinous and vitreous were later replaced with the terms "positive" and "negative" by William Watson and Benjamin Franklin.

• 1737 — C. F. du Fay and Francis Hauksbee the younger independently discover two kinds of frictional electricity: one generated from rubbing glass, the other from rubbing resin (later identified as positive and negative electrical charges).

• 1740 — Jean le Rond d’Alembert, in *Mémoire sur la réfraction des corps solides*, explains the process of refraction.

• 1745 — Pieter van Musschenbroek of Leiden (Leyden) independently discovers the Leyden (Leiden) jar, a primitive capacitor or "condenser" (term coined by Volta in 1782, derived from the Italian condensatore), with which the transient electrical energy generated by current friction machines could now be stored. He and his student Andreas Cunaeus used a glass jar filled with water into which a brass rod had been placed. He charged the jar by touching a wire leading from the electrical machine with one hand while holding the outside of the jar with the other. The energy could be discharged by completing an external circuit between the brass rod and another conductor, originally his hand, placed in contact with the outside of the jar. He also found that if the jar were placed on a piece of metal on a table, a shock would be received by touching this piece of metal with one hand and touching the wire connected to the electrical machine with the other.

• 1746 — Leonhard Euler develops the wave theory of light refraction and dispersion.

• 1747 — William Watson, while experimenting with a Leyden jar, observes that a discharge of static electricity causes electric current to flow and develops the concept of an electrical potential (voltage).

• 1752 — Benjamin Franklin establishes the link between lightning and electricity by the flying a kite into a thunderstorm and transferring some of the charge into a Leyden jar and showed that its properties were the
same as charge produced by an electrical machine. He is credited with utilizing the concepts of positive and negative charge in the explanation of then known electrical phenomenon. He theorized that there was an electrical fluid (which he proposed could be the luminiferous ether, which was used by others before and after him, to explain the wave theory of light) that was part of all material and all intervening space. The charge of any object would be neutral if the concentration of this fluid were the same both inside and outside of the body, positive if the object contained an excess of this fluid, and negative if there were a deficit. In 1749 he had documented the similar properties of lightning and electricity, such as that both an electric spark and a lightning flash produced light and sound, could kill animals, cause fires, melt metal, destroy or reverse the polarity of magnetism, and flowed through conductors and could be concentrated at sharp points. He was later able to apply the property of concentrating at sharp points by his invention of the lightning rod, for which he intentionally did not profit. He also investigated the Leyden jar, proving that the charge was stored on the glass and not in the water, as others had assumed.

- 1753 — C. M. (of Scotland, possibly Charles Morrison, of Greenock or Charles Marshall, of Aberdeen) proposes in the 17 February edition of Scots Magazine, an electrostatic telegraph system with 26 insulated wires, each corresponding to a letter of the alphabet and each connected to electrostatic machines. The receiving charged end was to electrostatically attract a disc of paper marked with the corresponding letter.
- 1767 — Joseph Priestley proposes an electrical inverse-square law
- 1774 — Georges-Louis LeSage builds an electrostatic telegraph system with 26 insulated wires conducting Leyden-jar charges to pith-ball electroscopes, each corresponding to a letter of the alphabet. Its range was only between rooms of his home.
- 1784 — Henry Cavendish defines the inductive capacity of dielectrics (insulators) and measures the specific inductive capacity of various substances by comparison with an air condenser.
- 1785 — Charles Coulomb introduces the inverse-square law of electrostatics
- 1786 — Luigi Galvani discovers "animal electricity" and postulates that animal bodies are storehouses of electricity. His invention of the voltaic cell leads to the invention the electric battery.
- 1791 — Luigi Galvani discovers galvanic electricity and bioelectricity through experiments following an observation that touching exposed muscles in frogs' legs with a scalpel which had been close to a static electrical machine caused them to jump. He called this "animal electricity". Years of experimentation in the 1780s eventually led him to the construction of an arc of two different metals (copper and zinc for example) by connecting the two metal pieces and then connecting their open ends across the nerve of a frog leg, producing the same muscular contractions (by completing a circuit) as originally accidentally observed. The use of different metals to produce an electrical spark is the basis that led Alessandro Volta in 1799 to his invention of his voltaic pile, which eventually became the galvanic battery.
- 1799 — Alessandro Volta, following Galvani’s discovery of galvanic electricity, creates a voltaic cell producing an electric current by the chemical action of several pairs of alternating copper (or silver) and zinc discs "piled" and separated by cloth or cardboard which had been soaked brine (salt water) or acid
to increase conductivity. In 1800 he demonstrates the production of light from a glowing wire conducting electricity. This was followed in 1801 by his construction of the first electric battery, by utilizing multiple voltaic cells. Prior to his major discoveries, in a letter of praise to the Royal Society 1793, Volta reported Luigi Galvani's experiments of the 1780s as the "most beautiful and important discoveries", regarding them as the foundation of future discoveries. Volta's inventions led to revolutionary changes with this method of the production of inexpensive, controlled electric current vs. existing frictional machines and Leyden jars. The electric battery became standard equipment in every experimental laboratory and heralded an age of practical applications of electricity.[10][page needed] The unit volt is named for his contributions.

- 1800 — William Herschel discovers infrared radiation from the Sun.
- 1800 — William Nicholson, Anthony Carlisle and Johann Ritter use electricity to decompose water into hydrogen and oxygen, thereby discovering the process of electrolysis, which led to the discovery of many other elements.
- 1800 — Alessandro Volta invents the voltaic pile, or "battery", specifically to disprove Galvani's animal electricity theory.

19th century

1801–1850

- 1801 — Johann Ritter discovers ultraviolet radiation from the Sun
- 1801 — Thomas Young demonstrates the wave nature of light and the principle of interference
- 1802 — Gian Domenico Romagnosi, Italian legal scholar, discovers that electricity and magnetism are related by noting that a nearby voltaic pile deflects a magnetic needle. He published his account in an Italian newspaper, but this was overlooked by the scientific community.
- 1803 — Thomas Young develops the Double-slit experiment and demonstrates the effect of interference.
- 1806 — Alessandro Volta employs a voltaic pile to decompose potash and soda, showing that they are the oxides of the previously unknown metals potassium and sodium. These experiments were the beginning of electrochemistry.
- 1808 — Étienne-Louis Malus discovers polarization by reflection
- 1809 — Étienne-Louis Malus publishes the law of Malus which predicts the light intensity transmitted by two polarizing sheets
- 1809 — Humphry Davy first publicly demonstrates the electric arc light.
- 1811 — François Jean Dominique Arago discovers that some quartz crystals continuously rotate the electric vector of light.
• 1814 — Joseph von Fraunhofer discovered and studied the dark absorption lines in the spectrum of the sun now known as Fraunhofer lines
• 1816 — David Brewster discovers stress birefringence
• 1818 — Siméon Poisson predicts the Poisson-Arago bright spot at the center of the shadow of a circular opaque obstacle
• 1818 — François Jean Dominique Arago verifies the existence of the Poisson-Arago bright spot
• 1820 — Hans Christian Ørsted, Danish physicist and chemist, unites the separate sciences of electricity and magnetism. He develops an experiment in which he notices a compass needle is deflected from magnetic north when an electric current from the battery he was using was switched on and off, convincing him that magnetic fields radiate from all sides of a live wire just as light and heat do, confirming a direct relationship between electricity and magnetism. He also observes that the movement of the compass-needle to one side or the other depends upon the direction of the current. Following intensive investigations, he published his findings, proving that a changing electric current produces a magnetic field as it flows through a wire. The oersted unit of magnetic induction is named for his contributions.
• 1820 — André-Marie Ampère, professor of mathematics at the École Polytechnique, a short time after learning of Ørsted's discovery that a magnetic needle is acted on by a voltaic current, conducts experiments and publishes a paper in Annales de Chimie et de Physique attempting to give a combined theory of electricity and magnetism. He shows that a coil of wire carrying a current behaves like an ordinary magnet and suggests that electromagnetism might be used in telegraphy. He mathematically develops Ampère's law describing the magnetic force between two electric currents. His mathematical theory explains known electromagnetic phenomena and predicts new ones. His laws of electrodynamics include the facts that parallel conductors currying current in the same direction attract and those carrying currents in the opposite directions repel one another. One of the first to develop electrical measuring techniques, he built an instrument utilizing a free-moving needle to measure the flow of electricity, contributing to the development of the galvanometer. In 1821, he proposed a telegraphy system utilizing one wire per "galvanometer" to indicate each letter, and reported experimenting successfully with such a system. However, in 1824, Peter Barlow reported its maximum distance was only 200 feet, and so was impractical. In 1826 he publishes the Memoir on the Mathematical Theory of Electrodynamic Phenomena, Uniquely Deduced from Experience containing a mathematical derivation of the electrodynamic force law. Following Faraday's discovery of electromagnetic induction in 1831, Ampère agreed that Faraday deserved full credit for the discovery.
• 1820 — Johann Salomo Christoph Schweigger, German chemist, physicist, and professor, builds the first sensitive galvanometer, wrapping a coil of wire around a graduated compass, an acceptable instrument for actual measurement as well as detection of small amounts of electric current, naming it after Luigi Galvani.
• 1821 — André-Marie Ampère announces his theory of electrodynamics, predicting the force that one current exerts upon another.
1821 — Thomas Johann Seebeck discovers the thermoelectric effect.

1821 — Augustin-Jean Fresnel derives a mathematical demonstration that polarization can be explained only if light is *entirely* transverse, with no longitudinal vibration whatsoever.

1825 — Augustin Fresnel phenomenologically explains optical activity by introducing circular birefringence.

1825 — William Sturgeon, founder of the first English Electric Journal, *Annals of Electricity*, found that an iron core inside a helical coil of wire connected to a battery greatly increased the resulting magnetic field, thus making possible the more powerful electromagnets utilizing a ferromagnetic core. Sturgeon also bent the iron core into a U-shape to bring the poles closer together, thus concentrating the magnetic field lines. These discoveries followed Ampère's discovery that electricity passing through a coiled wire produced a magnetic force and that of Dominique François Jean Arago finding that an iron bar is magnetized by putting it inside the coil of current-carrying wire, but Arago had not observed the increased strength of the resulting field while the bar was being magnetized.

1826 — Georg Simon Ohm states his Ohm's law of electrical resistance in the journals of Schweigger and Poggendorff, and also published in his landmark pamphlet *Die galvanische Kette mathematisch bearbeitet* in 1827. The unit ohm (Ω) of electrical resistance has been named in his honor.

1829 & 1830 — Francesco Zantedeschi publishes papers on the production of electric currents in closed circuits by the approach and withdrawal of a magnet, thereby anticipating Michael Faraday's classical experiments of 1831.

1831 — Michael Faraday began experiments leading to his discovery of the law of electromagnetic induction, though the discovery may have been anticipated by the work of Francesco Zantedeschi. His breakthrough came when he wrapped two insulated coils of wire around a massive iron ring, bolted to a chair, and found that upon passing a current through one coil, a momentary electric current was induced in the other coil. He then found that if he moved a magnet through a loop of wire, or vice versa, an electric current also flowed in the wire. He then used this principle to construct the electric dynamo, the first electric power generator. He proposed that electromagnetic forces extended into the empty space around the conductor, but did not complete that work. Faraday's concept of lines of flux emanating from charged bodies and magnets provided a way to visualize electric and magnetic fields. That mental model was crucial to the successful development of electromechanical devices which were to dominate the 19th century. His demonstrations that a changing magnetic field produces an electric field, mathematically modeled by Faraday's law of induction, would subsequently become one of Maxwell's equations. These consequently evolved into the generalization of field theory.

1831 — Macedonio Melloni uses a thermopile to detect infrared radiation.

1832 — Baron Pavel L'vovitch Schilling (Paul Schilling) creates the first electromagnetic telegraph, consisting of a single-needle system in which a code was used to indicate the characters. Only months later, Göttingen professors Carl Friedrich Gauss and Wilhelm Weber constructed a telegraph that was working.
two years before Schilling could put his into practice. Schilling demonstrated the long-distance transmission of signals between two different rooms of his apartment and was the first to put into practice a binary system of signal transmission.

- **1833** — Heinrich Lenz states Lenz's law: if an increasing (or decreasing) magnetic flux induces an electromotive force (EMF), the resulting current will oppose a further increase (or decrease) in magnetic flux, i.e., that an induced current in a closed conducting loop will appear in such a direction that it opposes the change that produced it. Lenz's law is one consequence of the principle of conservation of energy. If a magnet moves towards a closed loop, then the induced current in the loop creates a field that exerts a force opposing the motion of the magnet. Lenz's law can be derived from Faraday's law of induction by noting the negative sign on the right side of the equation. He also independently discovered Joule's law in **1842**; to honor his efforts, Russian physicists refer to it as the "Joule-Lenz law."

- **1833** — Michael Faraday announces his law of electrochemical equivalents

- **1834** — Heinrich Lenz determines the direction of the induced electromotive force (emf) and current resulting from electromagnetic induction. Lenz's law provides a physical interpretation of the choice of sign in Faraday's law of induction (1831), indicating that the induced emf and the change in flux have opposite signs.

- **1834** — Jean-Charles Peltier discovers the Peltier effect: heating by an electric current at the junction of two different metals.

- **1835** — Joseph Henry invents the electric relay, which is an electrical switch by which the change of a weak current through the windings of an electromagnet will attract an armature to open or close the switch. Because this can control (by opening or closing) another, much higher-power, circuit, it is in a broad sense a form of electrical amplifier. This made a practical electric telegraph possible. He was the first to coil insulated wire tightly around an iron core in order to make an extremely powerful electromagnet, improving on William Sturgeon's design, which used loosely coiled, uninsulated wire. He also discovered the property of self inductance independently of Michael Faraday.

- **1836** — William Fothergill Cooke invents a mechanical telegraph. **1837** with Charles Wheatstone invents the Cooke and Wheatstone needle telegraph. **1838** the Cooke and Wheatstone telegraph becomes the first commercial telegraph in the world when it is installed on the Great Western Railway.

- **1837** — Samuel Morse develops an alternative electrical telegraph design capable of transmitting long distances over poor quality wire. He and his assistant Alfred Vail develop the Morse code signaling alphabet. In **1838** Morse successfully tested the device at the Speedwell Ironworks near Morristown, New Jersey, and publicly demonstrated it to a scientific committee at the Franklin Institute in Philadelphia,
Pennsylvania. The first electric telegram using this device was sent by Morse on 24 May, 1844 from Baltimore to Washington, D.C., bearing the message "What hath God wrought?"

- 1838 — Michael Faraday uses Volta's battery to discover cathode rays.
- 1839 — Alexandre Edmond Becquerel observes the photoelectric effect with an electrode in a conductive solution exposed to light.
- 1840 — James Prescott Joule formulates Joule's Law (sometimes called the Joule-Lenz law) quantifying the amount of heat produced in a circuit as proportional to the product of the time duration, the resistance, and the square of the current passing through it.
- 1845 — Michael Faraday discovers that light propagation in a material can be influenced by external magnetic fields (Faraday effect).
- 1849 — Hippolyte Fizeau and Jean-Bernard Foucault measure the speed of light to be about 298,000 km/s.

1851–1900

- 1852 — George Gabriel Stokes defines the Stokes parameters of polarization.
- 1852 — Edward Frankland develops the theory of chemical valence.
- 1854 — Gustav Robert Kirchhoff, physicist and one of the founders of spectroscopy, publishes Kirchhoff's Laws on the conservation of electric charge and energy, which are used to determine currents in each branch of a circuit.
- 1855 — James Clerk Maxwell submits On Faraday's Lines of Force for publication containing a mathematical statement of Ampère's circuital law relating the curl of a magnetic field to the electrical current at a point.
- 1861 — the first transcontinental telegraph system spans North America by connecting an existing network in the eastern United States to a small network in California by a link between Omaha and Carson City via Salt Lake City. The slower Pony Express system ceased operation a month later.
- 1864 — James Clerk Maxwell publishes his papers on a dynamical theory of the electromagnetic field.
- 1865 — James Clerk Maxwell publishes his landmark paper A Dynamical Theory of the Electromagnetic Field, in which Maxwell's equations demonstrated that electric and magnetic forces are two complementary aspects of electromagnetism. He shows that the associated complementary electric and magnetic fields of electromagnetism travel through space, in the form of waves, at a constant velocity of $3.0 \times 10^8$ m/s. He also proposes that light is a form of electromagnetic radiation and that waves of oscillating electric and magnetic fields travel through empty space at a speed that could be predicted from simple electrical experiments. Using available data, he obtains a velocity of 310,740,000 m/s and states "This velocity is so nearly that of light, that it seems we have strong reason to conclude that light itself (including radiant heat,
and other radiations if any) is an electromagnetic disturbance in the form of waves propagated through the electromagnetic field according to electromagnetic laws."

- 1866 — the first successful transatlantic telegraph system was completed. Earlier submarine cable transatlantic cables installed in 1857 and 1858 failed after operating for a few days or weeks.
- 1869 — William Crookes invents the Crookes tube.
- 1873 — Willoughby Smith discovers the photoelectric effect in metals not in solution (i.e., selenium).
- 1871 — Lord Rayleigh discusses the blue sky law and sunsets (Rayleigh scattering)
- 1873 — J. C. Maxwell publishes A Treatise on Electricity and Magnetism which states that light is an electromagnetic phenomenon.
- 1874 — German scientist Karl Ferdinand Braun discovers the "unilateral conduction" of crystals. Braun patents the first solid state diode, a crystal rectifier, in 1899.
- 1875 — John Kerr discovers the electrically induced birefringence of some liquids
- 1878 — Thomas Edison, following work on a "multiplex telegraph" system and the phonograph, invents an improved incandescent light bulb. This was not the first electric light bulb but the first commercially practical incandescent light. In 1879 he produces a high-resistance lamp in a very high vacuum; the lamp lasts hundreds of hours. While the earlier inventors had produced electric lighting in lab conditions, Edison concentrated on commercial application and was able to sell the concept to homes and businesses by mass-producing relatively long-lasting light bulbs and creating a complete system for the generation and distribution of electricity.
- 1879 — Jožef Stefan discovers the Stefan–Boltzmann radiation law of a black body and uses it to calculate the first sensible value of the temperature of the Sun’s surface to be 5700 K
- 1880 — Edison discovers thermionic emission or the Edison effect.
- 1882 — Edison switches on the world's first electrical power distribution system, providing 110 volts direct current (DC) to 59 customers.
- 1884 — Oliver Heaviside reformulates Maxwell's original mathematical treatment of electromagnetic theory from twenty equations in twenty unknowns into four simple equations in four unknowns (the modern vector form of Maxwell's equations).
- 1886 — Oliver Heaviside coins the term inductance.
- 1887 — Heinrich Hertz invents a device for the production and reception of electromagnetic (EM) radio waves. His receiver consists of a coil with a spark gap.
- 1888 — Introduction of the induction motor, an electric motor that harnesses a rotating magnetic field produced by alternating current, independently invented by Galileo Ferraris and Nikola Tesla.
1888 — Heinrich Hertz demonstrates the existence of electromagnetic waves by building an apparatus that produced and detected UHF radio waves (or microwaves in the UHF region). He also found that radio waves could be transmitted through different types of materials and were reflected by others, the key to radar. His experiments explain reflection, refraction, polarization, interference, and velocity of electromagnetic waves.

1893 — Victor Schumann discovers the vacuum ultraviolet spectrum.

1895 — Wilhelm Conrad Röntgen discovers X-rays

1895 — Jagadis Chandra Bose gives his first public demonstration of electromagnetic waves

1896 — Arnold Sommerfeld solves the half-plane diffraction problem

1897 — J. J. Thomson discovers the electron.

1899 — Pyotr Lebedev measures the pressure of light on a solid body.

1900 — The Liénard–Wiechert potentials are introduced as time-dependent (retarded) electrodynamic potentials

1900 — Max Planck resolves the ultraviolet catastrophe by suggesting that black-body radiation consists of discrete packets, or quanta, of energy. The amount of energy in each packet is proportional to the frequency of the electromagnetic waves. The constant of proportionality is now called Planck’s constant in his honor.

20th century

1904 — John Ambrose Fleming invents the thermionic diode, the first electronic vacuum tube, which had practical use in early radio receivers.

1905 — Albert Einstein proposes the Theory of Special Relativity, in which he rejects the existence of the aether as unnecessary for explaining the propagation of electromagnetic waves. Instead, Einstein asserts as a postulate that the speed of light is constant in all inertial frames of reference, and goes on to demonstrate a number of revolutionary (and highly counter-intuitive) consequences, including time dilation, length contraction, the relativity of simultaneity, the dependence of mass on velocity, and the equivalence of mass and energy.

1905 — Einstein explains the photoelectric effect by extending Planck’s idea of light quanta, or photons, to the absorption and emission of photoelectrons. Einstein would later receive the Nobel Prize in Physics for this discovery, which launched the quantum revolution in physics.

1911 — Superconductivity is discovered by Heike Kamerlingh Onnes, who was studying the resistivity of solid mercury at cryogenic temperatures using the recently discovered liquid helium as a refrigerant. At the temperature of 4.2 K, he observed that the resistivity abruptly disappeared. For this discovery, he was awarded the Nobel Prize in Physics in 1913.
• 1919 — Albert A. Michelson makes the first interferometric measurements of stellar diameters at Mount Wilson Observatory (see history of astronomical interferometry)

• 1924 — Louis de Broglie postulates the wave nature of electrons and suggests that all matter has wave properties.

• 1946 — Martin Ryle and Vonberg build the first two-element astronomical radio interferometer (see history of astronomical interferometry)

• 1953 — Charles H. Townes, James P. Gordon, and Herbert J. Zeiger produce the first maser

• 1956 — R. Hanbury-Brown and R.Q. Twiss complete the correlation interferometer

• 1960 — Theodore Maiman produces the first working laser

• 1966 — Jefimenko introduces time-dependent (retarded) generalizations of Coulomb's law and the Biot–Savart law

• 1999 — M. Henny and others demonstrate the Fermionic Hanbury Brown and Twiss Experiment

Timeline of carbon nanotubes

1952

• Radushkevich and Lukyanovich publish a paper in the Soviet Journal of Physical Chemistry showing hollow graphitic carbon fibers that are 50 nanometers in diameter.

1955

• Hofer, Sterling and McCarney observe a growth of tubular carbon filaments, of 10–200 nm in diameter.

1958

• Hillert and Lange observe a growth of nanoscale tubular carbon filaments from n-heptane decomposition on iron at about 1000 °C.

1960

• Roger Bacon grows "graphite wiskers" in an arc-discharge apparatus and use electron microscopy to show that the structure consist of rolled up graphene sheets in concentric cylinders.
• Bollmann and Spreadborough discuss friction properties of carbon due to rolling sheets of graphene in Nature. Electron Microscope picture clearly shows MWCNT.

1971

• M.L. Lieberman reports growth of three different graphitic like filaments; tubular, twisted, and balloon like. TEM images and diffraction data shows that the hollow tubes are multi-walled carbon nanotubes (MWCNT).

1976

• A. Oberlin, Morinobu Endo, and T. Koyama reported CVD (Chemical Vapor Deposition) growth of nanometer-scale carbon fibers, and they also reported the discovery of carbon nanofibers, including that some were shaped as hollow tubes.

1979

• Arthur C. Clarke's science fiction novel The Fountains of Paradise popularizes the idea of a space elevator using "a continuous pseudo-one dimensional diamond crystal".

1982

• The continuous or floating-catalyst process was patented by Japanese researchers T. Koyama and Morinobu Endo.

1985

• Fullerenes discovered.

1987

• Howard G. Tennent of Hyperion Catalysis issued a U.S. patent for graphitic, hollow core "fibrils".
1991
- Nanotubes synthesized hollow carbon molecules and determined their crystal structure for the first time in the soot of arc discharge at NEC, by Japanese researcher Sumio Iijima.
- August — Nanotubes discovered in CVD by Al Harrington and Tom Maganas of Maganas Industries, leading to development of a method to synthesize monomolecular thin film nanotube coatings.

1992
- First theoretical predictions of the electronic properties of single-walled carbon nanotubes by groups at Naval Research Laboratory, USA; Massachusetts Institute of Technology; and NEC Corporation.

1993
- Groups led by Donald S. Bethune at IBM and Sumio Iijima at NEC independently discover single-wall carbon nanotubes and methods to produce them using transition-metal catalysts.

1995
- Swiss researchers are the first to demonstrate the electron emission properties of carbon nanotubes. German inventors Till Keesmann and Hubert Grosse-Wilde predicted this property of carbon nanotubes earlier in the year in their patent application.

1997
- First carbon nanotube single-electron transistors (operating at low temperature) are demonstrated by groups at Delft University and UC Berkeley.
- The first suggestion of using carbon nanotubes as optical antennas is made in the patent application of inventor Robert Crowley filed in January 1997.

1998
- First carbon nanotube field-effect transistors are demonstrated by groups at Delft University and IBM.
2000

- First demonstration proving that bending carbon nanotubes changes their resistance

2001

- April — First report on a technique for separating semiconducting and metallic nanotubes.

2002

- January — Multi-walled nanotubes demonstrated to be fastest known oscillators (> 50 GHz).

2003

- September — NEC announced stable fabrication technology of carbon nanotube transistors.

2004

- March — *Nature* published a photo of an individual 4 cm long single-wall nanotube (SWNT).

2005

- May — A prototype high-definition 10-centimetre flat screen made using nanotubes was exhibited.
- August — University of California finds Y-shaped nanotubes to be ready-made transistors.
- August — General Electric announced the development of an ideal carbon nanotube diode that operates at the "theoretical limit" (the best possible performance). A photovoltaic effect was also observed in the nanotube diode device that could lead to breakthroughs in solar cells, making them more efficient and thus more economically viable.
- August — Nanotube sheet synthesised with dimensions 5 × 100 cm.

2006

- March — IBM announces that they have built an electronic circuit around a CNT.
- March — Nanotubes used as a scaffold for damaged nerve regeneration.
- May — Method of placing nanotube accurately is developed by IBM.
- June — Gadget invented by Rice University that can sort nanotubes by size and electrical properties.
- July — Nanotubes were alloyed into the carbon fiber bike that was ridden by Floyd Landis to win the 2006 Tour de France.

**2009**

- April — Nanotubes incorporated in virus battery.
- A single-walled carbon nanotube was grown by chemical vapor deposition across a 10-micron gap in a silicon chip, then used in cold atom experiments, creating a blackhole like effect on single atoms.

**2012**

- January — IBM creates 9 nm carbon nanotube transistor that outperforms silicon.

**2013**

- January — Research team at Rice University announce developing a new wet-spun nanotech fiber. The new fiber is made with an industrial scalable process. The fibers reported in Science have about 10 times the tensile strength and electrical and thermal conductivity of the best previously reported wet-spun CNT fibers.
- September — Researchers build a carbon nanotube computer.

**Timeline of physical chemistry**

<table>
<thead>
<tr>
<th>Date</th>
<th>Person</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1088</td>
<td>Shen Kuo</td>
<td>First person to write of the magnetic needle compass and that it improved the accuracy of navigation by helping to employ the astronomical concept of True North at all times of the day, thus making the first, recorded, scientific observation of the magnetic field (as opposed to a theory grounded in superstition or mysticism).</td>
</tr>
<tr>
<td>1187</td>
<td>Alexander Neckham</td>
<td>First in Europe to describe the magnetic compass and its use in navigation.</td>
</tr>
<tr>
<td>1269</td>
<td>Pierre de Maricourt</td>
<td>Published the first extant treatise on the properties of magnetism and</td>
</tr>
<tr>
<td>Year</td>
<td>Person</td>
<td>Event</td>
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<tr>
<td>1550</td>
<td>Gerolamo Cardano</td>
<td>Wrote about electricity in <em>De Subtilitate</em> distinguishing, perhaps for the first time, between electrical and magnetic forces.</td>
</tr>
<tr>
<td>1600</td>
<td>William Gilbert</td>
<td>In <em>De Magnete</em>, expanded on Cardano's work (1550) and coined the New Latin word <em>electricus</em> from ἑλέκτρον (elektron), the Greek word for &quot;amber&quot; (from which the ancients knew an electric spark could be created by rubbing it with silk). Gilbert undertook a number of careful electrical experiments, in the course of which he discovered that many substances other than amber, such as sulphur, wax, glass, etc., were capable of manifesting electrostatic properties. Gilbert also discovered that a heated body lost its electricity and that moisture prevented the electrification of all bodies, due to the now well-known fact that moisture impairs the electrical insulation of such bodies. He also noticed that electrified substances attracted all other substances indiscriminately, whereas a magnet only attracted iron. The many discoveries of this nature earned for Gilbert the title of founder of the electrical sciences.</td>
</tr>
<tr>
<td>1646</td>
<td>Sir Thomas Browne</td>
<td>The first usage of the word <em>electricity</em> is ascribed to his work <em>Pseudodoxia Epidemica</em>.</td>
</tr>
<tr>
<td>1660</td>
<td>Otto von Guericke</td>
<td>Invented an early electrostatic generator. By the end of the 17th Century, researchers had developed practical means of generating electricity by friction by the use of an electrostatic generator, but the development of electrostatic machines did not begin in earnest until the 18th century, when they became fundamental instruments in the studies of the new science of electricity.</td>
</tr>
<tr>
<td>1667</td>
<td>Johann Joachim Becher</td>
<td>Stated the now-defunct scientific theory that postulated the existence of a fire-like element called &quot;phlogiston&quot; that was contained within combustible bodies and released during combustion. The theory was an attempt to explain processes such as combustion and the rusting of metals, which are now understood as oxidation, and which was ultimately disproved by Antoine Lavoisier in 1789.</td>
</tr>
<tr>
<td>1675</td>
<td>Robert Boyle</td>
<td>Discovered that electric attraction and repulsion can act across a vacuum and does not depend upon the air as a medium. He also added resin to the then-known list of &quot;electrics.&quot;</td>
</tr>
<tr>
<td>1678</td>
<td>Christiaan Huygens</td>
<td>Stated his theory to the French Academy of Sciences that light is a wave-like phenomenon.</td>
</tr>
<tr>
<td>1687</td>
<td>Sir Isaac Newton</td>
<td>Published <em>Philosophiae Naturalis Principia Mathematica</em>, by itself considered to be among the most influential books in the history of</td>
</tr>
</tbody>
</table>
science, laying the groundwork for most of classical mechanics. In this work, Newton described universal gravitation and the three laws of motion, which dominated the scientific view of the physical universe for the next three centuries. Newton showed that the motions of objects on Earth and of celestial bodies are governed by the same set of natural laws by demonstrating the consistency between Kepler's laws of planetary motion and his theory of gravitation, thus removing the last doubts about heliocentrism and advancing the scientific revolution.

In mechanics, Newton enunciated the principles of conservation of both momentum and angular momentum. (Eventually, it was determined that Newton's laws of classical mechanics were a special case of the more general theory of quantum mechanics for macroscopic objects (in the same way that Newton's laws of motion are a special case of Einstein's Theory of Relativity)).

<table>
<thead>
<tr>
<th>Year</th>
<th>Inventor</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1704</td>
<td>Sir Isaac Newton</td>
<td>In his work <em>Opticks</em>, Newton contended that light was made up of numerous small particles. This hypothesis could explain such features as light's ability to travel in straight lines and reflect off surfaces. However, this proposed theory was known to have its problems: although it explained reflection well, its explanation of refraction and diffraction was less satisfactory. In order to explain refraction, Newton postulated an &quot;Aethereal Medium&quot; transmitting vibrations faster than light, by which light, when overtaken, is put into &quot; Fits of easy Reflexion and easy Transmission&quot;, which he supposed caused the phenomena of refraction and diffraction.</td>
</tr>
<tr>
<td>1708</td>
<td>Brook Taylor</td>
<td>Obtained a remarkable solution of the problem of the &quot;centre of oscillation&quot; fundamental to the development of wave mechanics which, however, remained unpublished until May 1714.</td>
</tr>
<tr>
<td>1715</td>
<td>Brook Taylor</td>
<td>In <em>Methodus Incrementorum Directa et Inversa</em> (1715), he added a new branch to the higher mathematics, now designated the &quot;calculus of finite differences.&quot; Among other ingenious applications, he used it to determine the form of movement of a vibrating string, first successfully reduced by him to mechanical principles. The same work contained the celebrated formula known as Taylor's theorem, the importance of which remained unrecognized until 1772, when J. L. Lagrange realized its powers and termed it &quot;le principal fondement du calcul différentiel&quot; (&quot;the main foundation of differential calculus&quot;). Taylor's work thereby provided the cornerstone of the calculus of wave mechanics.</td>
</tr>
<tr>
<td>Year</td>
<td>Inventor</td>
<td>Event Description</td>
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<tr>
<td>1722</td>
<td>René Antoine Ferchault de Réaumur</td>
<td>Demonstrated that iron was transformed into steel through the absorption of some substance, now known to be carbon.</td>
</tr>
<tr>
<td>1729</td>
<td>Stephen Gray</td>
<td>Conducted a series of experiments that demonstrated the difference between conductors and non-conductors (insulators). From these experiments he classified substances into two categories: &quot;electrics&quot;, like glass, resin and silk, and &quot;non-electrics&quot;, like metal and water. Although Gray was the first to discover and deduce the property of electrical conduction, he incorrectly stated that &quot;electrics&quot; conducted charges while &quot;non-electrics&quot; held the charge.</td>
</tr>
<tr>
<td>1732</td>
<td>C. F. du Fay</td>
<td>Conducted several experiments and concluded that all objects, except metals, animals, and liquids, could be electrified by rubbing them and that metals, animals and liquids could be electrified by means of an &quot;electric machine&quot; (the name used at the time for electrostatic generators), thus discrediting Gray's &quot;electrics&quot; and &quot;non-electrics&quot; classification of substances (1729).</td>
</tr>
<tr>
<td>1737</td>
<td>C. F. du Fay and Francis Hauksbee the younger</td>
<td>Independently discovered what they believed to be two kinds of frictional electricity: one generated from rubbing glass, the other from rubbing resin. From this, Du Fay theorized that electricity consists of two &quot;electrical fluids&quot;: &quot;vitreous&quot; and &quot;resinous&quot;, that are separated by friction, and that neutralize each other when combined. This two-fluid theory would later give rise to the concept of positive and negative electrical charges devised by Benjamin Franklin.</td>
</tr>
<tr>
<td>1740</td>
<td>Jean le Rond d'Alembert</td>
<td>In <em>Mémoire sur la réfraction des corps solides</em>, explains the process of refraction.</td>
</tr>
<tr>
<td>1740s</td>
<td>Leonhard Euler</td>
<td>Disagreed with Newton's corpuscular theory of light in the <em>Opticks</em>, which was then the prevailing theory. His 1740s papers on optics helped ensure that the wave theory of light proposed by Christiaan Huygens would become the dominant mode of thought, at least until the development of the quantum theory of light.</td>
</tr>
<tr>
<td>1745</td>
<td>Pieter van Musschenbroek</td>
<td>At Leiden University, he invented the Leyden jar, a type of capacitor (also known as a &quot;condensor&quot;) for electrical energy in large quantities.</td>
</tr>
<tr>
<td>1747</td>
<td>William Watson</td>
<td>While experimenting with a Leyden jar (1745), he discovered the concept of an electrical potential (voltage) when he observed that a discharge of static electricity caused the electric current earlier observed by Stephen Gray to occur.</td>
</tr>
<tr>
<td>1752</td>
<td>Benjamin Franklin</td>
<td>Identified lightning with electricity when he discovered that lightning</td>
</tr>
</tbody>
</table>
conducted through a metal key could be used to charge a Leyden jar, thus proving that lightning was an electric discharge and current (1747). He is also attributed with the convention of using "negative" and "positive" to denote an electrical charge or potential.

<table>
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<tbody>
<tr>
<td>1766</td>
<td>Henry Cavendish</td>
<td>The first to recognize hydrogen gas as a discrete substance, by identifying the gas from a metal-acid reaction as &quot;flammable air&quot; and further finding in 1781 that the gas produces water when burned.</td>
</tr>
<tr>
<td>1771</td>
<td>Luigi Galvani</td>
<td>Invented the voltaic cell. Galvani made this discovery when he noted that two different metals (copper and zinc for example) were connected together and then both touched to different parts of a nerve of a frog leg at the same time, a spark was generated which made the leg contract. Although he incorrectly assumed that the electric current was proceeding from the frog as some kind of &quot;animal electricity&quot;, his invention of the voltaic cell was fundamental to the development of the electric battery.</td>
</tr>
<tr>
<td>1772</td>
<td>Antoine Lavoisier</td>
<td>Showed that diamonds are a form of carbon, when he burned samples of carbon and diamond then showed that neither produced any water and that both released the same amount of carbon dioxide per gram.</td>
</tr>
<tr>
<td>1772</td>
<td>Carl Wilhelm Scheele</td>
<td>Showed that graphite, which had been thought of as a form of lead, was instead a type of carbon.</td>
</tr>
<tr>
<td>1772</td>
<td>Daniel Rutherford</td>
<td>Discovered and studied nitrogen, calling it noxious air or fixed air because this gas constituted a fraction of air that did not support combustion. Nitrogen was also studied at about the same time by Carl Wilhelm Scheele, Henry Cavendish, and Joseph Priestley, who referred to it as burnt air or phlogisticated air. Nitrogen gas was inert enough that Antoine Lavoisier referred to it as &quot;mephitic air&quot; or azote, from the Greek word ἀζωτικός (azotos) meaning &quot;lifeless&quot;. Animals died in it, and it was the principal component of air in which animals had suffocated and flames had burned to extinction.</td>
</tr>
<tr>
<td>1772</td>
<td>Carl Wilhelm Scheele</td>
<td>Produced oxygen gas by heating mercuric oxide and various nitrates by about 1772. Scheele called the gas 'fire air' because it was the only known supporter of combustion, and wrote an account of this discovery in a manuscript he titled Treatise on Air and Fire, which he sent to his publisher in 1775. However, that document was not published until 1777.</td>
</tr>
<tr>
<td>1778</td>
<td>Carl Scheele and Antoine Lavoisier</td>
<td>Discovered that air is composed mostly of nitrogen and oxygen.</td>
</tr>
<tr>
<td>1781</td>
<td>Joseph Priestley</td>
<td>The first to utilize the electric spark to produce an explosion of hydrogen.</td>
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</tbody>
</table>
and oxygen, mixed in the proper proportions, to produce pure water.

<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
<th>Achievement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1784</td>
<td>Henry Cavendish</td>
<td>Discovered the inductive capacity of dielectrics (insulators) and, as early as 1778, measured the specific inductive capacity for beeswax and other substances by comparison with an air condenser.</td>
</tr>
<tr>
<td>1784</td>
<td>Charles-Augustin de Coulomb</td>
<td>Devised the torsion balance, by means of which he discovered what is known as Coulomb's law: the force exerted between two small electrified bodies varies inversely as the square of the distance; not as Franz Aepinus in his theory of electricity had assumed, merely inversely as the distance.</td>
</tr>
<tr>
<td>1788</td>
<td>Joseph-Louis Lagrange</td>
<td>Stated a re-formulation of classical mechanics that combines conservation of momentum with conservation of energy, now called Lagrangian mechanics, and which would be critical to the later development of a quantum mechanical theory of matter and energy.</td>
</tr>
<tr>
<td>1789</td>
<td>Antoine Lavoisier</td>
<td>In his text <em>Traité Élémentaire de Chimie</em> (often considered to be the first modern chemistry text), stated the first version of the law of conservation of mass, recognized and named oxygen (1778) and hydrogen (1783), abolished the phlogiston theory, helped construct the metric system, wrote the first extensive list of elements, and helped to reform chemical nomenclature.</td>
</tr>
<tr>
<td>1798</td>
<td>Louis Nicolas Vauquelin</td>
<td>In 1797 received samples of crocoite ore from which he produced chromium oxide (CrO3) by mixing crocoite with hydrochloric acid. In 1798, Vauquelin discovered that he could isolate metallic chromium by heating the oxide in a charcoal oven. He was also able to detect traces of chromium in precious gemstones, such as ruby or emerald.</td>
</tr>
<tr>
<td>1798</td>
<td>Louis Nicolas Vauquelin</td>
<td>Discovered beryllium in emerald (beryl) when he dissolved the beryl in sodium hydroxide, separating the aluminium hydroxide and beryllium compound from the silicate crystals, and then dissolving the aluminium hydroxide in another alkali solution to separate it from the beryllium.</td>
</tr>
<tr>
<td>1800</td>
<td>William Nicholson and Johann Ritter</td>
<td>Used electricity to decompose water into hydrogen and oxygen, thereby discovering the process of electrolysis, which led to the discovery of many other elements.</td>
</tr>
<tr>
<td>1800</td>
<td>Alessandro Volta</td>
<td>Invented the voltaic pile, or &quot;battery&quot;, specifically to disprove Galvani's animal electricity theory.</td>
</tr>
<tr>
<td>1801</td>
<td>Johann Wilhelm Ritter</td>
<td>Discovered ultraviolet light.</td>
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<tr>
<td>1803</td>
<td>Thomas Young</td>
<td>Double-slit experiment supports the wave theory of light and demonstrates the effect of interference.</td>
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<tr>
<td>Year</td>
<td>Name</td>
<td>Description</td>
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<tr>
<td>1806</td>
<td>Alessandro Volta</td>
<td>Employing a voltaic pile of approximately 250 cells, or couples, decomposed potash and soda, showing that these substances were respectively the oxides of potassium and sodium, which metals previously had been unknown. These experiments were the beginning of electrochemistry.</td>
</tr>
<tr>
<td>1807</td>
<td>John Dalton</td>
<td>Published his <em>Atomic Theory of Matter</em>.</td>
</tr>
<tr>
<td>1807</td>
<td>Sir Humphry Davy</td>
<td>First isolates sodium from caustic soda and potassium from caustic potash by the process of electrolysis.</td>
</tr>
<tr>
<td>1808</td>
<td>Sir Humphry Davy, Joseph Louis Gay-Lussac, and Louis Jacques Thénard</td>
<td>Boron isolated through the reaction of boric acid and potassium.</td>
</tr>
<tr>
<td>1809</td>
<td>Sir Humphry Davy</td>
<td>First publicly demonstrated the electric arc light.</td>
</tr>
<tr>
<td>1811</td>
<td>Amedeo Avogadro</td>
<td>Proposed that the volume of a gas (at a given pressure and temperature) is proportional to the number of atoms or molecules, regardless of the nature of the gas—a key step in the development of the Atomic Theory of Matter.</td>
</tr>
<tr>
<td>1817</td>
<td>Johan August Arfwedson and Jöns Jakob Berzelius</td>
<td>Arfwedson, then working in the laboratory of Berzelius, detected the presence of a new element while analyzing petalite ore. This element formed compounds similar to those of sodium and potassium, though its carbonate and hydroxide were less soluble in water and more alkaline. Berzelius gave the alkaline material the name &quot;lithos&quot;, from the Greek word λίθος (transliterated as lithos, meaning &quot;stone&quot;), to reflect its discovery in a solid mineral, as opposed to sodium and potassium, which had been discovered in plant tissues.</td>
</tr>
<tr>
<td>1819</td>
<td>Hans Christian Oersted</td>
<td>Discovered the deflecting effect of an electric current traversing a wire upon a suspended magnetic needle, thus deducing that magnetism and electricity were somehow related to each other.</td>
</tr>
<tr>
<td>1821</td>
<td>Augustin-Jean Fresnel</td>
<td>Demonstrated via mathematical methods that polarization could be explained only if light was <em>entirely</em> transverse, with no longitudinal vibration whatsoever. This finding was later very important to Maxwell's equations and to Einstein's Theory of Special Relativity. His use of two plane mirrors of metal, forming with each other an angle of nearly 180°, allowed him to avoid the diffraction effects caused (by the apertures) in the experiment of F. M. Grimaldi on interference. This allowed him to conclusively account for the phenomenon of interference in accordance with the wave theory. With François Arago he studied the laws of the interference of polarized rays. He obtained circularly polarized light by</td>
</tr>
<tr>
<td>Year</td>
<td>Author</td>
<td>Description</td>
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<tr>
<td>1821</td>
<td>André-Marie Ampère</td>
<td>Announced his celebrated theory of electrodynamics, relating the force one current exerts upon another by way of its electro-magnetic effects.</td>
</tr>
<tr>
<td>1821</td>
<td>Thomas Johann Seebeck</td>
<td>Discovered the thermoelectric effect.</td>
</tr>
<tr>
<td>1827</td>
<td>Georg Simon Ohm</td>
<td>Discovered the relationship between voltage, current, and resistance, making possible the development of electric circuitry and power transmission.</td>
</tr>
<tr>
<td>1831</td>
<td>Macedonio Melloni</td>
<td>Used a thermopile to detect infrared radiation.</td>
</tr>
<tr>
<td>1831</td>
<td>Michael Faraday</td>
<td>Discovered electromagnetic induction, making possible the invention of the electric motor and generator.</td>
</tr>
<tr>
<td>1833</td>
<td>William Rowan Hamilton</td>
<td>Stated a reformulation of classical mechanics that arose from Lagrangian mechanics, a previous reformulation of classical mechanics introduced by Joseph-Louis Lagrange in 1788, but which can be formulated without recourse to Lagrangian mechanics using symplectic spaces (see Mathematical Formalism). As with Lagrangian mechanics, Hamilton's equations provide a new and equivalent way of looking at classical mechanics. Generally, these equations do not provide a more convenient way of solving a particular problem. Rather, they provide deeper insights into both the general structure of classical mechanics and its connection to quantum mechanics as understood through Hamiltonian mechanics, as well as its connection to other areas of science.</td>
</tr>
<tr>
<td>1833</td>
<td>Michael Faraday</td>
<td>Announced his important law of electrochemical equivalents, viz.: &quot;The same quantity of electricity — that is, the same electric current — decomposes chemically equivalent quantities of all the bodies which it traverses; hence the weights of elements separated in these electrolytes are to each other as their chemical equivalents.&quot;</td>
</tr>
<tr>
<td>1834</td>
<td>Heinrich Lenz</td>
<td>Applied an extension of the law of conservation of energy to the non-conservative forces in electromagnetic induction to give the direction of the induced electromotive force (emf) and current resulting from electromagnetic induction. The law provides a physical interpretation of the choice of sign in Faraday's law of induction (1831), indicating that the induced emf and the change in flux have opposite signs.</td>
</tr>
<tr>
<td>1834</td>
<td>Jean-Charles Peltier</td>
<td>Discovered what is now called the Peltier effect: the heating effect of an electric current at the junction of two different metals.</td>
</tr>
<tr>
<td>1838</td>
<td>Michael Faraday</td>
<td>Using Volta's battery, Faraday discovered &quot;cathode rays&quot; when, during</td>
</tr>
<tr>
<td>Year</td>
<td>Inventor/Discoverer</td>
<td>Description</td>
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<tr>
<td>1839</td>
<td>Alexandre Edmond Becquerel</td>
<td>Observed the photoelectric effect via an electrode in a conductive solution exposed to light.</td>
</tr>
<tr>
<td>1852</td>
<td>Edward Frankland</td>
<td>Initiated the theory of valency by proposing that each element has a specific &quot;combining power&quot;, e.g. some elements such as nitrogen tend to combine with three other elements (e.g. $NO_3$) while others may tend to combine with five (e.g. $PO_5$), and that each element strives to fulfill its combining power (valency) quota.</td>
</tr>
<tr>
<td>1857</td>
<td>Heinrich Geissler</td>
<td>Invented the Geissler tube.</td>
</tr>
<tr>
<td>1858</td>
<td>Julius Plücker</td>
<td>Published the first of his classical researches on the action of magnets on the electric discharge of rarefied gases in Geissler tubes. He found that the discharge caused a fluorescent glow to form on the glass walls of the vacuum tube, and that the glow could be made to shift by applying a magnetic field to the tube. It was later shown by Johann Wilhelm Hittorf that the glow was produced by rays emitted from one of the electrodes (the cathode).</td>
</tr>
<tr>
<td>1859</td>
<td>Gustav Kirchhoff</td>
<td>Stated the &quot;black body problem&quot;, i.e. how does the intensity of the electromagnetic radiation emitted by a black body depend on the frequency of the radiation and the temperature of the body?</td>
</tr>
<tr>
<td>1865</td>
<td>Johann Josef Loschmidt</td>
<td>Estimated the average diameter of the molecules in air by a method that is equivalent to calculating the number of particles in a given volume of gas. This latter value, the number density of particles in an ideal gas, is now called the Loschmidt constant in his honour, and is approximately proportional to the Avogadro constant. The connection with Loschmidt is the root of the symbol $L$ sometimes used for the Avogadro constant, and German language literature may refer to both constants by the same name, distinguished only by the units of measurement.</td>
</tr>
<tr>
<td>1868</td>
<td>Norman Lockyer and Edward Frankland</td>
<td>On October 20 observed a yellow line in the solar spectrum, which he named the &quot;D3 Fraunhofer line&quot; because it was near the known D1 and D2 lines of sodium. He correctly concluded that it was caused by an element in the Sun unknown on Earth. Lockyer and Frankland named the element with the Greek word for the Sun, ἥλιος, &quot;helios.&quot;</td>
</tr>
<tr>
<td>1869</td>
<td>Dmitri Mendeleev</td>
<td>Devises the Periodic Table of the Elements.</td>
</tr>
</tbody>
</table>
| 1869 | Johann Wilhelm Hittorf      | Studied discharge tubes with energy rays extending from a negative electrode, the cathode. These rays, which he discovered but were later
called cathode rays by Eugen Goldstein, produced a fluorescence when they hit a tube's glass walls and, when interrupted by a solid object, cast a shadow.

<table>
<thead>
<tr>
<th>Year</th>
<th>Inventor/Discoverer</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1869</td>
<td>William Crookes</td>
<td>Invented the Crookes tube.</td>
</tr>
<tr>
<td>1873</td>
<td>Willoughby Smith</td>
<td>Discovered the photoelectric effect in metals not in solution (i.e., selenium).</td>
</tr>
<tr>
<td>1873</td>
<td>James Clerk Maxwell</td>
<td>Published his theory of electromagnetism in which light was determined to be an electromagnetic wave (field) that could be propagated in a vacuum.</td>
</tr>
<tr>
<td>1877</td>
<td>Ludwig Boltzmann</td>
<td>Suggested that the energy states of a physical system could be discrete.</td>
</tr>
<tr>
<td>1879</td>
<td>William Crookes</td>
<td>Showed that cathode rays (1838), unlike light rays, can be bent in a magnetic field.</td>
</tr>
<tr>
<td>1885</td>
<td>Johann Balmer</td>
<td>Discovered that the four visible lines of the hydrogen spectrum could be assigned integers in a series</td>
</tr>
<tr>
<td>1886</td>
<td>Henri Moissan</td>
<td>Isolated elemental fluorine after almost 74 years of effort by other chemists.</td>
</tr>
<tr>
<td>1886</td>
<td>Oliver Heaviside</td>
<td>Coined the term &quot;inductance.&quot;</td>
</tr>
<tr>
<td>1886</td>
<td>Eugen Goldstein</td>
<td>Goldstein had undertaken his own investigations of discharge tubes and had named the light emissions studied by others &quot;kathodenstrahlen&quot;, or cathode rays. In 1886, he discovered that discharge tubes with a perforated cathode also emit a glow at the cathode end. Goldstein concluded that in addition to the already-known cathode rays (later recognized as electrons) moving from the negatively charged cathode toward the positively charged anode, there is another ray that travels in the opposite direction. Because these latter rays passed through the holes, or channels, in the cathode, Goldstein called them &quot;kanalstrahlen&quot;, or canal rays. He determined that canal rays are composed of positive ions whose identity depends on the residual gas inside the tube. It was another of Helmholtz's students, Wilhelm Wien, who later conducted extensive studies of canal rays, and in time this work would become part of the basis for mass spectrometry.</td>
</tr>
<tr>
<td>1887</td>
<td>Albert A. Michelson and Edward W. Morley</td>
<td>Conducted what is now called the &quot;Michelson-Morley&quot; experiment, in which they disproved the existence of a luminiferous aether and that the speed of light remained constant relative to all inertial frames of reference. The full significance of this discovery was not understood until Albert Einstein published his Theory of Special Relativity.</td>
</tr>
<tr>
<td>1887</td>
<td>Heinrich Hertz</td>
<td>Discovered the production and reception of electromagnetic (EM) radio waves.</td>
</tr>
</tbody>
</table>
waves. His receiver consisted of a coil with a spark gap, where a spark would be seen upon detection of EM waves transmitted from another spark gap source.

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<tr>
<th>Year</th>
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<th>Description</th>
</tr>
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<tbody>
<tr>
<td>1888</td>
<td>Johannes Rydberg</td>
<td>Modified the Balmer formula to include the other series of lines, producing the Rydberg formula</td>
</tr>
<tr>
<td>1891</td>
<td>Alfred Werner</td>
<td>Proposed a theory of affinity and valence in which affinity is an attractive force issuing from the center of the atom which acts uniformly from there towards all parts of the spherical surface of the central atom.</td>
</tr>
<tr>
<td>1892</td>
<td>Heinrich Hertz</td>
<td>Showed that cathode rays (1838) could pass through thin sheets of gold foil and produce appreciable luminosity on glass behind them.</td>
</tr>
<tr>
<td>1893</td>
<td>Alfred Werner</td>
<td>Showed that the number of atoms or groups associated with a central atom (the &quot;coordination number&quot;) is often 4 or 6; other coordination numbers up to a maximum of 8 were known, but less frequent.</td>
</tr>
<tr>
<td>1893</td>
<td>Victor Schumann</td>
<td>Discovered the vacuum ultraviolet spectrum.</td>
</tr>
<tr>
<td>1895</td>
<td>Sir William Ramsay</td>
<td>Isolated helium on Earth by treating the mineral cleveite (a variety of uraninite with at least 10% rare earth elements) with mineral acids.</td>
</tr>
<tr>
<td>1895</td>
<td>Wilhelm Röntgen</td>
<td>Discovered X-rays with the use of a Crookes tube.</td>
</tr>
<tr>
<td>1896</td>
<td>Henri Becquerel</td>
<td>Discovered &quot;radioactivity&quot; a process in which, due to nuclear disintegration, certain elements or isotopes spontaneously emit one of three types of energetic entities: alpha particles (positive charge), beta particles (negative charge), and gamma particles (neutral charge).</td>
</tr>
<tr>
<td>1897</td>
<td>J. J. Thomson</td>
<td>Showed that cathode rays (1838) bend under the influence of both an electric field and a magnetic field. To explain this he suggested that cathode rays are negatively charged subatomic electrical particles or &quot;corpuscles&quot; (electrons), stripped from the atom; and in 1904 proposed the &quot;plum pudding model&quot; in which atoms have a positively charged amorphous mass (pudding) as a body embedded with negatively charged electrons (raisins) scattered throughout in the form of non-random rotating rings. Thomson also calculated the mass-to-charge ratio of the electron, paving the way for the precise determination of its electrical charge by Robert Andrews Millikan (1913).</td>
</tr>
<tr>
<td>1900</td>
<td>Max Planck</td>
<td>To explain black-body radiation (1862), he suggested that electromagnetic energy could only be emitted in quantized form, i.e. the energy could only be a multiple of an elementary unit $E = \hbar \nu$, where $\hbar$ is Planck's constant and $\nu$ is the frequency of the radiation.</td>
</tr>
<tr>
<td>1901</td>
<td>Frederick Soddy and Ernest Rutherford</td>
<td>Discovered nuclear transmutation when they found that radioactive thorium was converting itself into radium through a process of nuclear transmutation.</td>
</tr>
<tr>
<td>Year</td>
<td>Scientist(s)</td>
<td>Event</td>
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<tr>
<td>1902</td>
<td>Gilbert N. Lewis</td>
<td>To explain the octet rule (1893), he developed the &quot;cubical atom&quot; theory in which electrons in the form of dots were positioned at the corner of a cube and suggested that single, double, or triple &quot;bonds&quot; result when two atoms are held together by multiple pairs of electrons (one pair for each bond) located between the two atoms (1916).</td>
</tr>
<tr>
<td>1904</td>
<td>J. J. Thomson</td>
<td>Articulated the &quot;plumb-pudding&quot; model of the atom that was later experimentally disproved by Rutherford (1907)</td>
</tr>
<tr>
<td>1904</td>
<td>Richard Abegg</td>
<td>Noted the pattern that the numerical difference between the maximum positive valence, such as +6 for $H_2SO_4$, and the maximum negative valence, such as -2 for $H_2S$, of an element tends to be eight (Abegg's rule).</td>
</tr>
<tr>
<td>1905</td>
<td>Albert Einstein</td>
<td>Determined the equivalence of matter and energy.</td>
</tr>
<tr>
<td>1905</td>
<td>Albert Einstein</td>
<td>First to explain the effects of Brownian motion as caused by the kinetic energy (i.e., movement) of atoms, which was subsequently, experimentally verified by Jean Baptiste Perrin, thereby settling the century-long dispute about the validity of John Dalton's atomic theory.</td>
</tr>
<tr>
<td>1905</td>
<td>Albert Einstein</td>
<td>Published his Special Theory of Relativity.</td>
</tr>
<tr>
<td>1905</td>
<td>Albert Einstein</td>
<td>Explained the photoelectric effect (1839), i.e. that shining light on certain materials can function to eject electrons from the material, he postulated as based on Planck's quantum hypothesis (1900), that light itself consists of individual quantum particles (photons).</td>
</tr>
<tr>
<td>1907</td>
<td>Ernest Rutherford</td>
<td>To test the plum pudding model (1904), he fired positively charged alpha particles at gold foil and noticed that some bounced back, thus showing that atoms have a small-sized positively charged atomic nucleus at its center.</td>
</tr>
<tr>
<td>1909</td>
<td>Geoffrey Ingram Taylor</td>
<td>Demonstrated that interference patterns of light were generated even when the light energy introduced consisted of only one photon. This discovery of the wave–particle duality of matter and energy was fundamental to the later development of quantum field theory.</td>
</tr>
<tr>
<td>1909 and 1916</td>
<td>Albert Einstein</td>
<td>Showed that, if Planck's law of black-body radiation is accepted, the energy quanta must also carry momentum $p = h / \lambda$, making them full-fledged particles, albeit with no &quot;rest mass.&quot;</td>
</tr>
<tr>
<td>1911</td>
<td>Lise Meitner and Otto Hahn</td>
<td>Performed an experiment that showed that the energies of electrons emitted by beta decay had a continuous rather than discrete spectrum. This was in apparent contradiction to the law of conservation of energy, as it appeared that energy was lost in the beta decay process.</td>
</tr>
</tbody>
</table>
A second problem was that the spin of the Nitrogen-14 atom was 1, in contradiction to the Rutherford prediction of ½. These anomalies were later explained by the discoveries of the neutrino and the neutron.

<table>
<thead>
<tr>
<th>Year</th>
<th>Person</th>
<th>Event</th>
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<tbody>
<tr>
<td>1912</td>
<td>Henri Poincaré</td>
<td>Published an influential mathematical argument in support of the essential nature of energy quanta.</td>
</tr>
<tr>
<td>1913</td>
<td>Robert Andrews Millikan</td>
<td>Published the results of his &quot;oil drop&quot; experiment, in which he precisely determines the electric charge of the electron. Determination of the fundamental unit of electric charge made it possible to calculate the Avogadro constant (which is the number of atoms or molecules in one mole of any substance) and thereby to determine the atomic weight of the atoms of each element.</td>
</tr>
<tr>
<td>1913</td>
<td>Niels Bohr</td>
<td>To explain the Rydberg formula (1888), which correctly modeled the light emission spectra of atomic hydrogen, Bohr hypothesized that negatively charged electrons revolve around a positively charged nucleus at certain fixed &quot;quantum&quot; distances and that each of these &quot;spherical orbits&quot; has a specific energy associated with it such that electron movements between orbits requires &quot;quantum&quot; emissions or absorptions of energy.</td>
</tr>
<tr>
<td>1911</td>
<td>Ştefan Procopiu</td>
<td>Performed experiments in which he determined the correct value of electron's magnetic dipole moment, $\mu_B = 9.27 \times 10^{-21}$ erg·Oe$^{-1}$.</td>
</tr>
<tr>
<td>1916</td>
<td>Gilbert N. Lewis</td>
<td>Developed the Lewis dot structures that ultimately led to a complete understanding of the electronic covalent bond that forms the fundamental basis for our understanding of chemistry at the atomic level; he also coined the term &quot;photon&quot; in 1926.</td>
</tr>
<tr>
<td>1916</td>
<td>Arnold Sommerfeld</td>
<td>To account for the Zeeman effect (1896), i.e. that atomic absorption or emission spectral lines change when the light is first shone through a magnetic field, he suggested there might be &quot;elliptical orbits&quot; in atoms in addition to spherical orbits.</td>
</tr>
<tr>
<td>1918</td>
<td>Ernest Rutherford</td>
<td>Noticed that, when alpha particles were shot into nitrogen gas, his scintillation detectors showed the signatures of hydrogen nuclei. Rutherford determined that the only place this hydrogen could have come from was the nitrogen, and therefore nitrogen must contain hydrogen nuclei. He thus suggested that the hydrogen nucleus, which was known to have an atomic number of 1, was an elementary particle, which he decided must be the protons hypothesized by Eugen Goldstein (1886).</td>
</tr>
<tr>
<td>1919</td>
<td>Irving Langmuir</td>
<td>Building on the work of Lewis (1916), he coined the term &quot;covalence&quot;</td>
</tr>
</tbody>
</table>
and postulated that coordinate covalent bonds occur when the electrons of a pair come from the same atom, thus explaining the fundamental nature of chemical bonding and molecular chemistry.

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<tr>
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</tr>
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<tbody>
<tr>
<td>1922</td>
<td>Arthur Compton</td>
<td>Found that X-ray wavelengths increase due to scattering of the radiant energy by &quot;free electrons.&quot; The scattered quanta have less energy than the quanta of the original ray. This discovery, now known as the &quot;Compton effect&quot; or &quot;Compton scattering&quot;, demonstrates the &quot;particle&quot; concept of electromagnetic radiation.</td>
</tr>
<tr>
<td>1922</td>
<td>Otto Stern and Walther Gerlach</td>
<td>Stern–Gerlach experiment detects discrete values of angular momentum for atoms in the ground state passing through an inhomogeneous magnetic field leading to the discovery of the spin of the electron.</td>
</tr>
<tr>
<td>1923</td>
<td>Louis de Broglie</td>
<td>Postulated that electrons in motion are associated with waves the lengths of which are given by Planck's constant $h$ divided by the momentum of the electron: $\lambda = h/mv = h/p$.</td>
</tr>
<tr>
<td>1924</td>
<td>Satyendra Nath Bose</td>
<td>His work on quantum mechanics provides the foundation for Bose–Einstein statistics, the theory of the Bose–Einstein condensate, and the discovery of the boson.</td>
</tr>
<tr>
<td>1925</td>
<td>Friedrich Hund</td>
<td>Outlined the &quot;rule of maximum multiplicity&quot; which states that, when electrons are added successively to an atom, as many levels or orbits are singly occupied as possible before any pairing of electrons with opposite spin occurs, and also made the distinction that the inner electrons in molecules remain in their atomic orbitals and only the valence electrons need occupy the molecular orbitals involving both nuclei of the atoms participating in a covalent bond.</td>
</tr>
<tr>
<td>1925</td>
<td>Werner Heisenberg</td>
<td>Developed the matrix mechanics formulation of quantum mechanics.</td>
</tr>
<tr>
<td>1925</td>
<td>Wolfgang Pauli</td>
<td>Outlined the &quot;Pauli exclusion principle&quot; which states that no two identical fermions may occupy the same quantum state simultaneously.</td>
</tr>
<tr>
<td>1926</td>
<td>Gilbert Lewis</td>
<td>Coined the term photon, which he derived from the Greek word for light, φως (transliterated phōs).</td>
</tr>
<tr>
<td>1926</td>
<td>Erwin Schrödinger</td>
<td>Used De Broglie's electron wave postulate (1924) to develop a &quot;wave equation&quot; that represents mathematically the distribution of a charge of an electron distributed through space, being spherically symmetric or prominent in certain directions, i.e. directed valence bonds, which gave the correct values for spectral lines of the hydrogen atom.</td>
</tr>
<tr>
<td>1927</td>
<td>Charles Drummond Ellis (along with James Chadwick and colleagues)</td>
<td>Finally established clearly that the beta decay spectrum is really continuous, ending all controversies.</td>
</tr>
<tr>
<td>Year</td>
<td>Name</td>
<td>Contributions</td>
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</tr>
<tr>
<td>1927</td>
<td>Walter Heitler</td>
<td>Used Schrödinger's wave equation (1926) to show how two hydrogen atom wavefunctions join together, with plus, minus, and exchange terms, to form a covalent bond.</td>
</tr>
<tr>
<td>1927</td>
<td>Robert Mulliken</td>
<td>In 1927 Mulliken worked, in coordination with Hund, to develop a molecular orbital theory where electrons are assigned to states that extend over an entire molecule and in 1932 introduced many new molecular orbital terminologies, such as σ bond, π bond, and δ bond.</td>
</tr>
<tr>
<td>1928</td>
<td>Paul Dirac</td>
<td>In the Dirac equations, Paul Dirac integrated the principle of special relativity with quantum electrodynamics and thereby hypothesized the existence of the positron.</td>
</tr>
<tr>
<td>1928</td>
<td>Linus Pauling</td>
<td>Outlined the nature of the chemical bond in which he used Heitler's quantum mechanical covalent bond model (1927) to describe the quantum mechanical basis for all types of molecular structure and bonding, thereby suggesting that different types of bonds in molecules can become equalized by the rapid shifting of electrons, a process called &quot;resonance&quot; (1931), such that resonance hybrids contain contributions from the different possible electronic configurations.</td>
</tr>
<tr>
<td>1929</td>
<td>John Lennard-Jones</td>
<td>Introduced the linear combination of atomic orbitals approximation for the calculation of molecular orbitals.</td>
</tr>
<tr>
<td>1930</td>
<td>Wolfgang Pauli</td>
<td>In a famous letter written by him, Pauli suggested that, in addition to electrons and protons, atoms also contained an extremely light neutral particle which he called the &quot;neutron&quot;. He suggested that this &quot;neutron&quot; was also emitted during beta decay and had simply not yet been observed. Later it was determined that this particle was actually the almost massless neutrino.</td>
</tr>
<tr>
<td>1931</td>
<td>Walther Bothe and Herbert Becker</td>
<td>Found that, if the very energetic alpha particles emitted from polonium fell on certain light elements, specifically beryllium, boron, or lithium, an unusually penetrating radiation was produced. At first this radiation was thought to be gamma radiation, although it was more penetrating than any gamma rays known, and the details of experimental results were very difficult to interpret on this basis. Some scientists began to hypothesize the possible existence of another fundamental, atomic particle.</td>
</tr>
<tr>
<td>1932</td>
<td>Irène Joliot-Curie and Frédéric Joliot</td>
<td>Showed that if the unknown radiation generated by alpha particles fell on paraffin or any other hydrogen-containing compound, it ejected protons of very high energy. This was not in itself inconsistent with the proposed gamma ray nature of the new radiation, but detailed</td>
</tr>
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</table>
quantitative analysis of the data became increasingly difficult to reconcile with such a hypothesis.

<table>
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<tbody>
<tr>
<td>1932</td>
<td>James Chadwick</td>
<td>Performed a series of experiments showing that the gamma ray hypothesis for the unknown radiation produced by alpha particles was untenable, and that the new particles must be the neutrons hypothesized by Enrico Fermi. Chadwick suggested that, in fact, the new radiation consisted of uncharged particles of approximately the same mass as the proton, and he performed a series of experiments verifying his suggestion.</td>
</tr>
<tr>
<td>1932</td>
<td>Werner Heisenberg</td>
<td>Applied perturbation theory to the two-electron problem and showed how resonance arising from electron exchange could explain exchange forces.</td>
</tr>
<tr>
<td>1932</td>
<td>Mark Oliphant</td>
<td>Building upon the nuclear transmutation experiments of Ernest Rutherford done a few years earlier, fusion of light nuclei (hydrogen isotopes) was first observed by Oliphant in 1932. The steps of the main cycle of nuclear fusion in stars were subsequently worked out by Hans Bethe throughout the remainder of that decade.</td>
</tr>
<tr>
<td>1932</td>
<td>Carl D. Anderson</td>
<td>Experimentally proves the existence of the positron.</td>
</tr>
<tr>
<td>1933</td>
<td>Leó Szilárd</td>
<td>First theorized the concept of a nuclear chain reaction. He filed a patent for his idea of a simple nuclear reactor the following year.</td>
</tr>
<tr>
<td>1934</td>
<td>Enrico Fermi</td>
<td>Studies the effects of bombarding uranium isotopes with neutrons.</td>
</tr>
<tr>
<td>1934</td>
<td>N. N. Semyonov</td>
<td>Develops the total quantitative chain chemical reaction theory. The idea of the chain reaction, developed by Semyonov, is the basis of various high technologies using the incineration of gas mixtures. The idea was also used for the description of the nuclear reaction.</td>
</tr>
<tr>
<td>1935</td>
<td>Hideki Yukawa</td>
<td>Published his hypothesis of the Yukawa Potential and predicted the existence of the pion, stating that such a potential arises from the exchange of a massive scalar field, such as would be found in the field of the pion. Prior to Yukawa's paper, it was believed that the scalar fields of the fundamental forces necessitated massless particles.</td>
</tr>
<tr>
<td>1936</td>
<td>Carl D. Anderson</td>
<td>Discovered muons while studying cosmic radiation.</td>
</tr>
<tr>
<td>1937</td>
<td>Carl Anderson</td>
<td>Experimentally proved the existence of the pion.</td>
</tr>
<tr>
<td>1938</td>
<td>Charles Coulson</td>
<td>Made the first accurate calculation of a molecular orbital wavefunction with the hydrogen molecule.</td>
</tr>
<tr>
<td>1938</td>
<td>Otto Hahn, Fritz Strassmann, Lise Meitner, and Otto Robert Frisch</td>
<td>Hahn and Strassmann sent a manuscript to Naturwissenschaften reporting they had detected the element barium after bombarding uranium with neutrons. Simultaneously, they communicated these results</td>
</tr>
</tbody>
</table>
to Meitner. Meitner, and her nephew Frisch, correctly interpreted these results as being nuclear fission. Frisch confirmed this experimentally on 13 January 1939.

<table>
<thead>
<tr>
<th>Year</th>
<th>Discoverer(s)</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>1939</td>
<td>Leó Szilárd and Enrico Fermi</td>
<td>Discovered neutron multiplication in uranium, proving that a chain reaction was indeed possible.</td>
</tr>
<tr>
<td>1942</td>
<td>Kan-Chang Wang</td>
<td>First proposed the use of beta capture to experimentally detect neutrinos.</td>
</tr>
<tr>
<td>1942</td>
<td>Enrico Fermi</td>
<td>Created the first artificial self-sustaining nuclear chain reaction, called Chicago Pile-1 (CP-1), in a racquets court below the bleachers of Stagg Field at the University of Chicago on December 2, 1942.</td>
</tr>
<tr>
<td>1945</td>
<td>Manhattan Project</td>
<td>First nuclear fission explosion.</td>
</tr>
<tr>
<td>1947</td>
<td>G. D. Rochester and C. C. Butler</td>
<td>Published two cloud chamber photographs of cosmic ray-induced events, one showing what appeared to be a neutral particle decaying into two charged pions, and one which appeared to be a charged particle decaying into a charged pion and something neutral. The estimated mass of the new particles was very rough, about half a proton's mass. More examples of these &quot;V-particles&quot; were slow in coming, and they were soon given the name kaons.</td>
</tr>
<tr>
<td>1948</td>
<td>Sin-Itiro Tomonaga and Julian Schwinger</td>
<td>Independently introduced perturbative renormalization as a method of correcting the original Lagrangian of a quantum field theory so as to eliminate an infinite series of counterterms that would otherwise result.</td>
</tr>
<tr>
<td>1951</td>
<td>Clemens C. J. Roothaan and George G. Hall</td>
<td>Derived the Roothaan-Hall equations, putting rigorous molecular orbital methods on a firm basis.</td>
</tr>
<tr>
<td>1952</td>
<td>Manhattan Project</td>
<td>First explosion of a thermonuclear bomb.</td>
</tr>
<tr>
<td>1952</td>
<td>Herbert S. Gutowsky</td>
<td>Physical chemistry of solids investigated by NMR: structure, spectroscopy and relaxation</td>
</tr>
<tr>
<td>1952</td>
<td>Charles P. Slichter</td>
<td>Introduced Chemical shifts, NQR in solids, the first NOE experiments</td>
</tr>
<tr>
<td>1952</td>
<td>Albert W. Overhauser</td>
<td>First investigation of dynamic polarization in solids/NOE-Nuclear Overhauser Effect</td>
</tr>
<tr>
<td>1953</td>
<td>Charles H. Townes (collaborating with James P. Gordon, and Herbert J. Zeiger)</td>
<td>Built and reported the first ammonia maser; received a Nobel prize in 1964 for his experimental success in producing coherent radiation by atoms and molecules.</td>
</tr>
<tr>
<td>*1958—1959</td>
<td>Edward Raymond Andrew, A. Bradbury, and R. G. Eades; and independently, I. J. Lowe</td>
<td>described the technique of magic angle spinning.</td>
</tr>
<tr>
<td>Year</td>
<td>Name(s)</td>
<td>Description</td>
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<tr>
<td>1956</td>
<td>P. Kuroda</td>
<td>Predicted that self-sustaining nuclear chain reactions should occur in natural uranium deposits.</td>
</tr>
<tr>
<td>1956</td>
<td>Clyde L. Cowan and Frederick Reines</td>
<td>Experimentally proved the existence of the neutrino.</td>
</tr>
<tr>
<td>1957</td>
<td>William Alfred Fowler, Margaret Burbidge, Geoffrey Burbidge, and Fred Hoyle</td>
<td>In their 1957 paper <em>Synthesis of the Elements in Stars</em>, they explained how the abundances of essentially all but the lightest chemical elements could be explained by the process of nucleosynthesis in stars.</td>
</tr>
<tr>
<td>1961</td>
<td>Claus Jönsson</td>
<td>Performed Young's double-slit experiment (1909) for the first time with particles other than photons by using electrons and with similar results, confirming that massive particles also behaved according to the wave–particle duality that is a fundamental principle of quantum field theory.</td>
</tr>
<tr>
<td>1964</td>
<td>Murray Gell-Mann and George Zweig</td>
<td>Independently proposed the quark model of hadrons, predicting the arbitrarily named up, down, and strange quarks. Gell-Mann is credited with coining the term &quot;quark&quot;, which he found in James Joyce's book <em>Finnegans Wake</em>.</td>
</tr>
<tr>
<td>1968</td>
<td>Stanford University</td>
<td>Deep inelastic scattering experiments at the Stanford Linear Accelerator Center (SLAC) showed that the proton contained much smaller, point-like objects and was therefore not an elementary particle. Physicists at the time were reluctant to identify these objects with quarks, instead calling them &quot;partons&quot; — a term coined by Richard Feynman. The objects that were observed at SLAC would later be identified as up and down quarks. Nevertheless, &quot;parton&quot; remains in use as a collective term for the constituents of hadrons (quarks, antiquarks, and gluons). The strange quark's existence was indirectly validated by the SLAC's scattering experiments: not only was it a necessary component of Gell-Mann and Zweig's three-quark model, but it provided an explanation for the kaon (K) and pion (π) hadrons discovered in cosmic rays in 1947.</td>
</tr>
<tr>
<td>1974</td>
<td>Pier Giorgio Merli</td>
<td>Performed Young's double-slit experiment (1909) using a single electron with similar results, confirming the existence of quantum fields for massive particles.</td>
</tr>
<tr>
<td>1995</td>
<td>Eric Cornell, Carl Wieman and Wolfgang Ketterle</td>
<td>The first &quot;pure&quot; Bose–Einstein condensate was created by Eric Cornell, Carl Wieman, and co-workers at JILA. They did this by cooling a dilute vapor consisting of approximately two thousand rubidium-87 atoms to below 170 nK using a combination of laser cooling and magnetic evaporative cooling. About four months later, an independent effort led...</td>
</tr>
</tbody>
</table>
by Wolfgang Ketterle at MIT created a condensate made of sodium-23. Ketterle's condensate had about a hundred times more atoms, allowing him to obtain several important results such as the observation of quantum mechanical interference between two different condensates.

<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>CERN</td>
<td>CERN scientists published experimental results in which they claimed to have observed indirect evidence of the existence of a quark–gluon plasma, which they call a &quot;new state of matter&quot;.</td>
</tr>
</tbody>
</table>

**Timeline of nuclear fusion**

**1920s**

- **1920**
  - Based on F.W. Aston's measurements of the masses of low-mass elements and Einstein's discovery that $E=mc^2$, Arthur Eddington proposes that large amounts of energy released by fusing small nuclei together provides the energy source that powers the stars.
  - Henry Norris Russell notes that the relationship in the Hertzsprung–Russell diagram suggests a hot core rather than burning throughout the star. Eddington uses this to calculate that the core would have to be about 40 million Kelvin. This remains a matter of some debate because it appears to be much higher than what observations suggest, which is about one-third to one-half that value.

- **1928**
  - George Gamow introduces the mathematical basis for quantum tunnelling.

- **1929**
  - Atkinson and Houtermans provide the first calculations of the rate of nuclear fusion in stars. Based on Gamow's tunnelling, they show fusion can occur at lower energies than previously believed. When used with Eddington's calculations of the required fusion rates in stars, their calculations demonstrate this would occur at the lower temperatures that Eddington had calculated.

**1930s**

- **1932**
  - Ernest Rutherford's Cavendish Laboratory at Cambridge University begins nuclear experiments with a particle accelerator built by John Cockcroft and Ernest Walton.
  - In April, Walton produces the first man-made fission by using protons from the accelerator to split lithium into alpha particles.
Using an updated version of the equipment firing deuterium rather than hydrogen, Mark Oliphant discovered helium-3 and tritium, and that heavy hydrogen nuclei could be made to react with each other. This is the first direct demonstration of fusion in the lab.

- **1938**
  - Kantrowitz and Jacobs of the NACA Langley Research Center built a toroidal magnetic bottle and heat the plasma with a 150 W radio source. Hoping to heat the plasma to millions of degrees, the system fails to do so and they abandon it. This is the first attempt to make a working fusion reactor.

- **1939**
  - Peter Thonemann develops a detailed plan for a pinch device, but is told to do other work for his thesis.
  - Hans Bethe provides detailed calculations of the proton–proton chain reaction that powers stars. This work results in a Nobel Prize for Physics.

1940s

- **1948**
  - Tuck and Ware built a prototype pinch device out of old radar parts at Imperial University.

1950s

- **1950**
  - The tokamak, a type of magnetic confinement fusion device, was proposed by Soviet scientists Andrei Sakharov and Igor Tamm.

- **1951**
  - Edward Teller and Stanislaw Ulam at Los Alamos National Laboratory (LANL) develop the Teller-Ulam design for the thermonuclear weapon, allowing for the development of multi-megaton weapons.
  - Fusion work in the UK is classified after the Klaus Fuchs affair.
  - A press release from Argentina claims that their Huemul Project had produced controlled nuclear fusion. This prompted a wave of responses in other countries, especially the U.S.
    - Lyman Spitzer dismisses the Argentinian claims, but while thinking about it comes up with the stellarator concept. Funding is arranged under Project Matterhorn and develops into the Princeton Plasma Physics Laboratory.
    - Tuck introduces the British pinch work to LANL. He develops the Perhapsatron under the codename Project Sherwood. The project name is a play on his name via Friar Tuck.
• Richard F. Post presents his magnetic mirror concept and also receives initial funding, eventually moving to Lawrence Livermore National Laboratory (LLNL).

• In the UK, repeated requests for more funding that had previously been turned down are suddenly approved. Within a short time, three separate efforts are started, one at Harwell and two at Atomic Weapons Establishment (Aldermaston). Early planning for a much larger machine at Harwell begins.

• Using the Huemul release as leverage, Soviet researchers find their funding proposals rapidly approved. Work on linear pinch machines begins that year.

• 1952
  o Ivy Mike shot off Operation Ivy, the first detonation of a thermonuclear weapon, yields 10.4 megatons of TNT out of a fusion fuel of liquid deuterium.
  o Cousins and Ware build a larger toroidal pinch device in England and demonstrated that the plasma in pinch devices is inherently unstable.

• 1953
  o The Soviet RDS-6S test, code named "Joe 4", demonstrated a fission/fusion/fission ("Layercake") design for a nuclear weapon.
  o Linear pinch devices in the US and USSR attempted to take the reactions to fusion levels without worrying about stability. Both reported detections of neutrons, which were later explained as non-fusion in nature.

• 1954
  o Early planning for the large ZETA device at Harwell begins. The name is a take-off on small experimental fission reactors which often had "zero energy" in their name, ZEEP being an example.
  o Edward Teller gives a now-famous speech on plasma stability in magnetic bottles at the Princeton Gun Club. His work suggests that most magnetic bottles are inherently unstable, outlining what is today known as the interchange instability.

• 1955
  o At the first Atoms for Peace meeting in Geneva, Homi J. Bhabha predicts that fusion will be in commercial use within two decades. This prompts a number of countries to begin fusion research; Japan, France and Sweden all start programs this year or the next.

• 1956
  o Experimental research of tokamak systems started at Kurchatov Institute, Moscow by a group of Soviet scientists led by Lev Artsimovich.
Construction of ZETA begins at Harwell.

Igor Kurchatov gives a talk at Harwell on pinch devices, revealing for the first time that the USSR is also working on fusion. He details the problems they are seeing, mirroring those in the US and UK.

In August, a number of articles on plasma physics appear in various Soviet journals.

In the wake of the Kurchatov's speech, the US and UK begin to consider releasing their own data. Eventually they settle on a release prior to the 2nd Atoms for Peace conference in Geneva.

In the US, at LANL, Scylla I achieved the first controlled thermonuclear plasma through the development of a θ-pinch design, a derivative of earlier Z-pinch Perhapsatron device experiments.

ZETA is completed in the summer, it will be the largest fusion machine for a decade.

Initial results in ZETA appear to suggest the machine has successfully reached basic fusion temperatures. UK researchers start pressing for public release, while the US demurs.

Scientists at the AEI Research laboratory in Harwell reported that the Sceptre III plasma column remained stable for 300 to 400 microseconds, a dramatic improvement on previous efforts. Working backward, the team calculated that the plasma had an electrical resistivity around 100 times that of copper, and was able to carry 200 kA of current for 500 microseconds in total.

In January, the US and UK release large amounts of data, with the ZETA team claiming fusion. Other researchers, notably Artsimovich and Spitzer, are skeptical. In May, the claims of fusion have to be retracted.

American, British and Soviet scientists began to share previously classified controlled fusion research as part of the Atoms for Peace conference in Geneva in September. It is the largest international scientific meeting to date. It becomes clear that basic pinch concepts are not successful.

With Scylla I, Tuck's team at Los Alamos followed up their plasma breakthrough from the prior year to demonstrate the first controlled thermonuclear fusion in any laboratory. Though it came too late to be announced at Geneva. This θ-pinch approach will ultimately be abandoned as calculations show it cannot scale up to produce a reactor.

1960s

1960

After considering the concept for some time, John Nuckolls publishes the concept of inertial confinement fusion. The laser, introduced the same year, appears to be a suitable "driver".
1961
- The Soviet Union test the Tsar Bomba (50 megatons), the most powerful thermonuclear weapon ever.

1964
- Plasma temperatures of approximately 40 million degrees Celsius and a few billion deuteron-deuteron fusion reactions per discharge were achieved at LANL with the Scylla IV device.

1965
- At an international meeting at the UK's new fusion research centre in Culham, the Soviets release early results showing greatly improved performance in toroidal pinch machines. The announcement is met by scepticism, especially by the UK team who's ZETA was largely identical.
- At the same meeting, odd results from the ZETA machine are published. Studying these effects leads to the reversed field pinch concept.
- By the end of the meeting, it is clear that most fusion efforts have stalled. All of the major designs, including the stellarator, pinch machines and magnetic mirrors are all losing plasma at rates that are simply too high to be useful in a reactor setting. Less-known designs like the levatron and astron are faring no better.
- The 12-beam "4 pi laser" using ruby as the lasing medium is developed at Lawrence Livermore National Laboratory (LLNL) includes a gas-filled target chamber of about 20 centimeters in diameter.

1967
- Demonstration of Farnsworth-Hirsch Fusor appeared to generate neutrons in a nuclear reaction.
- Hans Bethe wins the 1967 Nobel Prize in physics for his publication on how fusion powers the stars in work of 1939.

1968
- Further results from the T-3 tokamak, similar to the toroidal pinch machine mentioned in 1965, claims temperatures to be over an order of magnitude higher than any other device. The Western scientists remain highly sceptical.

1969
- The Soviets invite a UK team from ZETA to perform independent measurements on T-3, confirming their results. This leads to a "veritable stampede" of tokamak construction around the world.

1970s

1970
● The Model C stellarator is quickly converted to the Symmetrical Tokamak, matching the Soviet results. With an apparent solution to the magnetic bottle problem in-hand, plans begin for a larger machine to test the scaling.

● Kapchinskii and Teplyakov introduce a particle accelerator for heavy ions that appears suitable as an ICF driver in place of lasers.

- 1972
  ● The first neodymium-doped glass (Nd:glass) laser for ICF research, the "Long Path laser" is completed at LLNL and is capable of delivering ~50 joules to a fusion target.

- 1973
  ● Design work on JET, the Joint European Torus, begins.

- 1974
  ● J.B. Taylor re-visited ZETA results of 1958 and explained that the quiet-period was in fact very interesting. This led to the development of reversed field pinch, now generalised as "self-organising plasmas", an ongoing line of research.

  ● KMS Fusion was the only private sector company to pursue controlled thermonuclear fusion research using laser technology. Despite limited resources and numerous business problems KMS successfully demonstrated fusion from the Inertial Confinement Fusion (ICF) process. They achieved compression of a deuterium-tritium pellet from laser-energy in December 1973, and on May 1, 1974 carried out the world's first successful laser-induced fusion. Neutron-sensitive nuclear emulsion detectors, developed by Nobel Prize winner Robert Hofstadter, were used to provide evidence of this discovery.

  ● Beams using mature high-energy accelerator technology are hailed as the elusive "brand-X" laser capable of driving fusion implosions for commercial power. The Livingston Curve, from Stanford SLAC Education Group, is modified to show the energy needed for fusion to occur. Experiments commence on the single beam LLNL Cyclops laser, testing new optical designs for future ICF lasers.

- 1975
  ● The Princeton Large Torus (PLT), the follow-on to the Symmetrical Tokamak, begins operation. It soon surpasses the best Soviet machines and sets several temperature records that are above what is needed for a commercial reactor. PLT continues to set records until it is decommissioned.

- 1976
  ● Workshop, called by the US-ERDA (now DoE) at the Claremont Hotel in Berkeley, CA for an ad-hoc two-week summer study. Fifty senior scientists from the major US ICF programs and accelerator laboratories participated, with program heads and Nobel laureates also attending. In the closing address, Dr. C. Martin Stickley, then Director of US-ERDA's Office of Inertial Fusion, announced the conclusion was "no showstoppers" on the road to fusion energy.
The two beam Argus laser is completed at LLNL and experiments involving more advanced laser-target interactions commence.

Based on the continued success of the PLT, the DOE selects a larger Princeton design for further development. Initially designed simply to test a commercial-sized tokamak, the DOE team gives them the explicit goal of running on a deuterium-tritium fuel as opposed to test fuels like hydrogen or deuterium. The project is given the name Tokamak Fusion Test Reactor (TFTR).

1977

- The 20 beam Shiva laser at LLNL is completed, capable of delivering 10.2 kilojoules of infrared energy on target. At a price of $25 million and a size approaching that of a football field, the Shiva laser is the first of the "megalasers" at LLNL and brings the field of ICF research fully within the realm of "big science".
- The JET project is given the go-ahead by the EC, choosing an ex-RAF airfield south east of Oxford, UK as its site.

1978

- As PLT continues to set new records, Princeton is given additional funding to adapt TFTR with the explicit goal of reaching breakeven.

1979

- LANL successfully demonstrates the radio frequency quadrupole accelerator (RFQ).
- ANL and Hughes Research Laboratories demonstrate required ion source brightness with xenon beam at 1.5MeV.
- Foster Panel reports to US-DoE's Energy Research and Advisory Board that High-energy heavy ion fusion (HIF) is the "conservative approach" to fusion power. Listing HIF's advantages in his report, John Foster remarked: "...now that is kind of exciting." After DoE Office of Inertial Fusion completed review of programs, Director Gregory Canavan decides to accelerate the HIF effort.

1980s

1982

- HIBALL study by German and US institutions, Garching uses the high repetition rate of the RF accelerator driver to serve four reactor chambers and first-wall protection using liquid lithium inside the chamber cavity.
- Tore Supra construction starts at Cadarache, France. Its superconducting magnets will permit it to generate a strong permanent toroidal magnetic field.
high-confinement mode (H-mode) discovered in tokamaks.

• 1983
  o JET, the largest operational magnetic confinement plasma physics experiment is completed on time and on budget. First plasmas achieved.
  o The NOVETTE laser at LLNL comes on line and is used as a test bed for the next generation of ICF lasers, specifically the NOVA laser.

• 1984
  o The huge 10 beam NOVA laser at LLNL is completed and switches on in December. NOVA would ultimately produce a maximum of 120 kilojoules of infrared laser light during a nanosecond pulse in a 1989 experiment.

• 1985
  o National Academy of Sciences reviewed military ICF programs, noting HIF’s major advantages clearly but averring that HIF was "supported primarily by other [than military] programs". The review of ICF by the National Academy of Sciences marked the trend with the observation: "The energy crisis is dormant for the time being." Energy becomes the sole purpose of heavy ion fusion.

• 1988
  o The T-15, Soviet tokamak with superconducting helium-cooled coils completed.
  o The Conceptual Design Activity for the International Thermonuclear Experimental Reactor (ITER), the successor to T-15, TFTR, JET and JT-60, begins. Participants include EURATOM, Japan, the Soviet Union and United States. It ended in 1990.
  o The first plasma produced at Tore Supra in April.

• 1989
  o On March 23, two Utah electrochemists, Stanley Pons and Martin Fleischmann, announced that they had achieved cold fusion: fusion reactions which could occur at room temperatures. However, they made their announcements before any peer review of their work was performed, and no subsequent experiments by other researchers revealed any evidence of fusion.

1990s

• 1990
  o Decision to construct the National Ignition Facility "beamlet" laser at LLNL is made.

• 1991
  o The START Tokamak fusion experiment begins in Culham. The experiment would eventually achieve a record beta (plasma pressure compared to magnetic field pressure) of 40% using
a neutral beam injector. It was the first design that adapted the conventional toroidal fusion experiments into a tighter spherical design.

- **1992**
  - The Engineering Design Activity for the ITER starts with participants EURATOM, Japan, Russia and United States. It ended in 2001.
  - The United States and the former republics of the Soviet Union cease nuclear weapons testing.

- **1993**
  - The TFTR tokamak at Princeton (PPPL) experiments with a 50% deuterium, 50% tritium mix, eventually producing as much as 10 megawatts of power from a controlled fusion reaction.

- **1994**
  - NIF Beamlet laser is completed and begins experiments validating the expected performance of NIF.
  - The USA declassifies information about indirectly driven (hohlraum) target design.
  - Comprehensive European-based study of HIF driver begins, centered at the Gesellschaft für Schwerionenforschung (GSI) and involving 14 laboratories, including USA and Russia. The Heavy Ion Driven Inertial Fusion (HIDIF) study will be completed in 1997.

- **1996**
  - A record is reached at Tore Supra: a plasma duration of two minutes with a current of almost 1 million amperes driven non-inductively by 2.3 MW of lower hybrid frequency waves (i.e. 280 MJ of injected and extracted energy). This result was possible due to the actively cooled plasma-facing components installed in the machine.

- **1997**
  - The JET tokamak in the UK produces 16 MW of fusion power - the current world record for fusion power. Four megawatts of alpha particle self-heating was achieved.
  - LLNL study compared projected costs of power from ICF and other fusion approaches to the projected future costs of existing energy sources.
  - Groundbreaking ceremony held for the National Ignition Facility (NIF).

- **1998**
  - The JT-60 tokamak in Japan produced a high performance reversed shear plasma with the equivalent fusion amplification factor $Q_{eq}$ of 1.25 - the current world record of $Q$, fusion energy gain factor.
  - Results of European-based study of heavy ion driven fusion power system (HIDIF, GSI-98-06) incorporates telescoping beams of multiple isotopic species. This technique multiplies the 6-D phase space usable for the design of HIF drivers.

- **1999**
The United States withdraws from the ITER project.

The START experiment is succeeded by MAST.

2000s

- **2001**
  - Building construction for the immense 192-beam 500-terawatt NIF project is completed and construction of laser beam-lines and target bay diagnostics commences, expecting to take its first full system shot in 2010.
  - Negotiations on the Joint Implementation of ITER begin between Canada, countries represented by the European Union, Japan and Russia.

- **2002**
  - Claims and counter-claims are published regarding bubble fusion, in which a table-top apparatus was reported as producing small-scale fusion in a liquid undergoing acoustic cavitation. Like cold fusion (see 1989), it is later dismissed.
  - European Union proposes Cadarache in France and Vandellos in Spain as candidate sites for ITER while Japan proposes Rokkasho.

- **2003**
  - The United States rejoins the ITER project with China and Republic of Korea also joining. Canada withdraws.
  - Cadarache in France is selected as the European Candidate Site for ITER.
  - Sandia National Laboratories begins fusion experiments in the Z machine.

- **2004**
  - The United States drops its own projects, recognising an inability to match EU progress (Fusion Ignition Research Experiment (FIRE)), and focuses resources on ITER.

- **2005**
  - Following final negotiations between the EU and Japan, ITER chooses Cadarache over Rokkasho for the site of the reactor. In concession, Japan is able to host the related materials research facility and granted rights to fill 20% of the project's research posts while providing 10% of the funding.
  - The NIF fires its first bundle of eight beams achieving the highest ever energy laser pulse of 152.8 kJ (infrared).

- **2006**
  - China's EAST test reactor is completed, the first tokamak experiment to use superconducting magnets to generate both the toroidal and poloidal fields.
2009
- Construction of the NIF reported as complete.
- Ricardo Betti, the third Under Secretary, responsible for Nuclear Energy, testifies before Congress: "IFE [ICF for energy production] has no home".

2010s

2010
- HIF-2010 Symposium in Darmstadt Germany. Robert J. Burke presented on Single Pass (Heavy Ion Fusion) HIF and Charles Helsley made a presentation on the commercialization of HIF within the decade.

2011
- May 23–26, Workshop for Accelerators for Heavy Ion Fusion at Lawrence Berkeley National Laboratory, presentation by Robert J. Burke on "Single Pass Heavy Ion Fusion". The Accelerator Working Group publishes recommendations supporting moving RF accelerator driven HIF toward commercialization.

2012
- Stephen Slutz & Roger Vesey of Sandia National Labs publish a paper in Physical Review Letters presenting a computer simulation of the MagLIF concept showing it can produce high gain. According to the simulation, a 70 Mega Amp Z-pinch facility in combination with a Laser may be able to produce a spectacular energy return of 1000 times the expended energy. A 60 MA facility would produce a 100x yield.
- JET announces a major breakthrough in controlling instabilities in a fusion plasma.
- In August Robert J. Burke presents updates to the SPRFD HIF process and Charles Helsley presents the Economics of SPRFD at the 19th International HIF Symposium at Berkeley, California. Industry was there in support of ion generation for SPRFD.
- Fusion Power Corporation SPRFD patent allowed in Russia.

2013
- China's EAST tokamak test reactor achieves a record confinement time of 30 seconds for plasma in the high-confinement mode (H-mode), thanks to improvements in heat dispersal from tokamak walls. This is an improvement of an order of magnitude with respect to state-of-the-art reactors.

2014
US Scientists at NIF successfully generate more energy from fusion reactions than the energy absorbed by the nuclear fuel.

- **2015**
  - Germany conducts the first plasma discharge in Wendelstein 7-X, a large-scale stellarator capable of steady-state plasma confinement under fusion conditions.

- **2017**
  - China's EAST tokamak test reactor achieves a stable 101.2-second steady-state high confinement plasma, setting a world record in long-pulse H-mode operation on the night of July 3.

- **2018**
  - MIT scientists find a way to remove the excess heat from nuclear fusion reactors.

**Timeline of crystallography**

**18th Century**

- **1723** – Moritz Anton Cappeller introduces the term ‘crystallography’.
- **1766** – Pierre-Joseph Macquer, in his *Dictionnaire de Chymie*, promotes mechanisms of crystallization based on the idea that crystals are composed of polyhedral molecules (*primitive integrantes*).
- **1772** – Jean-Baptiste L. Romé de l'Isle develops geometrical ideas on crystal structure in his *Essai de Cristallographie*.
- **1781** – Abbé René Just Haüy (often termed the "Father of Modern Crystallography") discovers that crystals always cleave along crystallographic planes. Based on this observation, and the fact that the inter-facial angles in each crystal species always have the same value, Haüy concluded that crystals must be periodic and composed of regularly arranged rows of tiny polyhedra (*molécules intégrantes*). This theory explained why all crystal planes are related by small rational numbers (the law of rational indices).
- **1783** – Jean-Baptiste L. Romé de l'Isle in the second edition of his *Cristallographie* uses the contact goniometer to discover the law of constant interfacial angles: angles are constant and characteristic for crystals of the same chemical substance.
- **1784** – René Just Haüy publishes his Law of Decrements: a crystal is composed of molecules arranged periodically in three dimensions.
- **1795** – René Just Haüy lectures on his Law of Symmetry: “[…] the manner in which Nature creates crystals is always obeying […] the law of the greatest possible symmetry, in the sense that oppositely situated but corresponding parts are always equal in number, arrangement, and form of their faces”.

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19th Century


- 1815 – René Just Haüy publishes his Law of Symmetry.

- 1815 – Christian Samuel Weiss, founder of the dynamist school of crystallography, develops a geometric treatment of crystals in which crystallographic axes are the basis for classification of crystals rather than Haüy’s polyhedral molecules.

- 1822 – Friedrich Mohs attempts to bring the molecular approach of Haüy and the geometric approach of Weiss into agreement.

- 1823 – Franz Ernst Neumann invents a system of crystal face notation, by using the reciprocals of the intercepts with crystal axes, which becomes the standard for the next 60 years.

- 1824 – Ludwig August Seeber conceives of the concept of using an array of discrete (molecular) points to represent a crystal.

- 1826 – Moritz Ludwig Frankenheim derives the 32 crystal classes by using the crystallographic restriction, consistent with Haüy’s laws, that only 2, 3, 4 and 6-fold rotational axes are permitted.

- 1830 – Johann F. C. Hessel publishes an independent geometrical derivation of the 32 point groups (crystal classes).

- 1839 – William Hallowes Miller invents zonal relations by projecting the faces of a crystal upon the surface of a circumscribed sphere. Miller indices are defined which form a notation system in crystallography for planes in crystal (Bravais) lattices.

- 1840 – Gabriel Delafosse, independently of Seeber, represents crystal structure as an array of discrete points generated by defined translations.

- 1842 – Moritz Frankenheim derives 15 different theoretical networks of points in space not dependent on molecular shape.

- 1848 – Louis Pasteur discovers that sodium ammonium tartrate can crystallize in left- and right-handed forms and showed that the two forms can rotate polarized light in opposite directions. This was the first demonstration of molecular chirality, and also the first explanation of isomerism.

- 1850 – Auguste Bravais derives the 14 space lattices.

- 1869 – Axel Gadolin, independently of Hessel, derives the 32 crystal classes using stereographic projection.

- 1879 – Leonhard Sohncke lists the 65 crystallographic point systems using rotations and reflections in addition to translations.

- 1891 – Derivation of the 230 space groups (by adding mirror-image symmetry to Sohncke’s work) by a collaborative effort of Evgraf Fedorov and Arthur Schoenflies.
1894 - William Barlow, using a sphere packing approach, independently derives the 230 space groups.

1895 - Wilhelm Conrad Röntgen on 8 November 1895 produced and detected electromagnetic radiation in a wavelength range now known as X-rays or Röntgen rays, an achievement that earned him the first Nobel Prize in Physics in 1901. X-rays became the major mode of crystallographic research in the 20th century.

20th Century

1912 - Max von Laue discovers diffraction patterns from crystals in an x-ray beam.

1912 - Bragg diffraction, expressed through Bragg’s law, is first presented by Lawrence Bragg on 11 November 1912 to the Cambridge Philosophical Society.

1913 - Lawrence Bragg publishes the first observation of x-ray diffraction by crystals.

1914 - Max von Laue wins the Nobel Prize in Physics "for his discovery of the diffraction of X-rays by crystals."

1915 - William and Lawrence Bragg share the Nobel Prize in Physics "for their services in the analysis of crystal structure by means of X-rays."

1916 - Peter Debye and Paul Scherrer discover powder (polycrystalline) diffraction.

1917 - Alfred Hull independently discovers powder diffraction in researching the crystal structure of iron.

1923 - Roscoe Dickinson and Albert Raymond, and independently, H.J. Gonell and H. Mark, first show that an organic molecule, specifically hexamethylenetetramine, could be characterized by x-ray crystallography.


1926 - Victor Goldschmidt distinguishes between atomic and ionic radii and postulates some rules for atom substitution in crystal structures.

1928 - Felix Machatschki, working with Goldschmidt, shows that silicon can be replaced by aluminium in feldspar structures.

1928 - Kathleen Lonsdale uses x-rays to determine that the structure of benzene is a flat hexagonal ring.

1929 - Linus Pauling formulated a set of rules to describe the structure of complex ionic crystals.

1930 - Lawrence Bragg assembles the first classification of silicates, describing their structure in terms of grouping of SiO₄ tetrahedra.

1934 - Arthur Patterson introduces the Patterson function which uses diffraction intensities to determine the interatomic distances within a crystal, setting limits to the possible phase values for the reflected x-rays.

1934 - The first volumes in the series of International Tables for Crystallography are published.
• 1936 - Peter Debye wins the Nobel Prize in Physics "for his contributions to our knowledge of molecular structure through his investigations on dipole moments and on the diffraction of X-rays and electrons in gases."
• 1937 - Clinton Joseph Davisson and George Paget Thomson share the Nobel Prize in physics "for their experimental discovery of the diffraction of electrons by crystals."
• 1946 - Foundation of the International Union of Crystallography.
• 1946 - James Batcheller Sumner shares the Nobel Prize in Chemistry "for his discovery that enzymes can be crystallized".
• 1949 - Clifford Shull opens a new field of magnetic crystallography based on neutron diffraction.
• 1950 - Karle and Hauptman introduce useful formulae for phase determination, known as Direct Methods.
• 1951 - Bijvoet and his colleagues, using anomalous scattering, confirm Emil Fischer's arbitrary assignment of absolute configuration, in relation to the direction of optical rotation of polarized light, was correct in practice.
• 1951 - Linus Pauling determines the structure of the α-helix and the β-sheet in polypeptide chains for which he won the 1954 Nobel prize in Chemistry.
• 1952 - David Sayre suggests that the phase problem could be more easily solved by having at least one more intensity measurement beyond those of the Bragg peaks in each dimension. This concept is understood today as oversampling.
• 1952 - Geoffrey Wilkinson and Ernst Otto Fischer determine the structure of ferrocene, the first metallic sandwich compound, for which they win the 1973 Nobel prize in Chemistry.
• 1953 - Determination of the structure of DNA by 3 British teams, for which Watson, Crick and Wilkins win the 1962 Nobel Prize in Physiology or Medicine in 1962 (Franklin’s death in 1958 made her ineligible for the award).
• 1954 - Linus Pauling wins the Nobel Prize in Chemistry "for his research into the nature of the chemical bond and its application to the elucidation of the structure of complex substances", specifically the determination of the structure of the α-helix and the β-sheet in polypeptide chains.”
• 1960 - John Kendrew determines the structure of myoglobin for which he shares the 1962 Nobel Prize in Chemistry.
• 1960 - After many years of research, Max Perutz determines the structure of haemoglobin for which he shares the 1962 Nobel Prize in Chemistry.
• 1962 - Michael Rossmann and David Blow lay the foundation for the molecular replacement approach which provides phase information without requiring additional experimental effort.
• 1962 - Max Perutz and John Kendrew share the Nobel Prize for Chemistry "for their studies of the structures of globular proteins", namely haemoglobin and myoglobin respectively.
• 1962 - James Watson, Francis Crick and Maurice Wilkins win the Nobel Prize in Physiology or Medicine "for their discoveries concerning the molecular structure of nucleic acids and its significance for information transfer in living material," specifically for their determination of the structure of DNA.

• 1964 - Dorothy Hodgkin wins the Nobel Prize for Chemistry "for her determinations by X-ray techniques of the structures of important biochemical substances." The substances included penicillin and vitamin B12.

• 1967 - Hugo Rietveld invents the Rietveld refinement method for computation of crystal structures.

• 1968 - Aaron Klug and David DeRosier use electron microscopy to visualise the structure of the tail of bacteriophage T4, a common virus, thus signalling a breakthrough in macromolecular structure determination.

• 1968 - Dorothy Hodgkin, after 35 years of work, finally deciphers the structure of insulin.

• 1971 - Establishment of the Protein Data Bank (PDB). At PDB, Edgar Meyer develops the first general software tools for handling and visualizing protein structural data.

• 1973 - Alex Rich’s group publish the first report of a polynucleotide crystal structure - that of the yeast transfer RNA (tRNA) for phenylalanine.

• 1973 - Geoffrey Wilkinson and Ernst Fischer share the Nobel Prize in Chemistry “for their pioneering work, performed independently, on the chemistry of the organometallic, so called sandwich compounds”, specifically the structure of ferrocene.

• 1976 - William Lipscomb won the Nobel Prize in Chemistry “for his studies on the structure of boranes illuminating problems of chemical bonding.”

• 1978 - Stephen C. Harrison provides the first high-resolution structure of a virus: tomato bushy stunt virus which is icosahedral in form.

• 1980 - Jerome Karle and Wayne Hendrickson develop multi-wavelength anomalous dispersion (MAD) a technique to facilitate the determination of the three-dimensional structure of biological macromolecules via a solution of the phase problem.

• 1982 - Aaron Klug wins the Nobel Prize in Chemistry “for his development of crystallographic electron microscopy and his structural elucidation of biologically important nucleic acid-protein complexes.”

• 1984 - Dan Shechtman discovers quasicrystals for which he receives the Nobel Prize in Chemistry in 2011. These structures have no unit cell and no periodic translational order but have long-range bond orientational order, which generates a defined diffraction pattern.

• 1984 - Aaron Klug and his colleagues provide an advance in determining the structure of protein–nucleic acid complexes when they solve the structure of the 206-kDa nucleosome core particle.
• 1985 - Jerome Karle shares the Nobel Prize in Chemistry with Herbert A. Hauptman "for their outstanding achievements in the development of direct methods for the determination of crystal structures". Karle developed the theoretical basis for multiple-wavelength anomalous diffraction (MAD).

• 1985 - Hartmut Michel and his colleagues report the first high-resolution X-ray crystal structure of an integral membrane protein when they publish the structure of a photosynthetic reaction centre. Michel, Deisenhofer and Huber share the 1988 Nobel Prize in Chemistry for this work.

• 1986 - Ernst Ruska shares the Nobel Prize in Physics "for his fundamental work in electron optics, and for the design of the first electron microscope".

• 1986 - Johann Deisenhofer, Robert Huber and Hartmut Michel share the Nobel Prize in Chemistry "for the determination of the three-dimensional structure of a photosynthetic reaction centre."

• 1991 - Georg E. Schulz and colleagues report the structure of a bacterial porin, a membrane protein with a cylindrical shape (a ‘β-barrel’).

• 1992 - The International Union of Crystallography changes the IUCr’s definition of a crystal to “any solid having an essentially discrete diffraction pattern” thus formally recognizing quasicrystals.

• 1994 - Abrahams et al. reported the structure of an F1-ATPase which uses the proton-motive force across the inner mitochondrial membrane to facilitate the synthesis of adenosine triphosphate (ATP).

• 1994 - Bertram Brockhouse and Clifford Shull share the Nobel Prize in Physics "for pioneering contributions to the development of neutron scattering techniques for studies of condensed matter". Specifically, Brockhouse "for the development of neutron spectroscopy" and Shull "for the development of the neutron diffraction technique."

• 1997 - The X-ray crystal structure of bacteriorhodopsin was the first time the lipidic cubic phase (LCP) was used to facilitate the crystallization of a membrane protein; LCP has since been used to obtain the structures of many unique membrane proteins, including G protein-coupled receptors (GPCRs).

• 1997 - Paul D. Boyer and John E. Walker share one half of the Nobel Prize in Chemistry "for their elucidation of the enzymatic mechanism underlying the synthesis of adenosine triphosphate (ATP)" Walker determined the crystal structure of ATP synthase, and this structure confirmed a mechanism earlier proposed by Boyer, mainly on the basis of isotopic studies.

21st Century

• 2000 - Hadju and his colleagues calculated that they could use Sayre’s ideas from the 1950s, to implement a ‘diffraction before destruction’ concept, using an X-ray free-electron laser (XFEL).

• 2001 - Harry Noller’s group publish the 5.5-Å structure of the complete Thermus thermophilus 70S ribosome. This structure revealed that the major functional regions of the ribosome were based on RNA, establishing the primordial role of RNA in translation.
2001 - Roger Kornberg's group publish the 2.8-Å structure of Saccharomyces cerevisiae RNA polymerase. The structure allowed both transcription initiation and elongation mechanisms to be deduced. Simultaneously, this group reported the structure of free RNA polymerase II, which contributed towards the eventual visualisation of the interaction between DNA, RNA, and the ribosome.

2007 - Two X-ray crystal structures of a GPCR, the human β2 adrenergic receptor, were published. Because many drugs elicit their biological effect(s) by binding to a GPCR, the structures of these and other GPCRs may be used to develop efficacious drugs with few side effects.

2009 - Venkatraman Ramakrishnan, Thomas A. Steitz and Ada E. Yonath share the Nobel Prize in Chemistry "for studies of the structure and function of the ribosome."

2011 - Dan Shechtman receives the Nobel Prize in chemistry "for the discovery of quasicrystals."

2017 - Jacques Dubochet, Joachim Frank and Richard Henderson share the Nobel Prize in chemistry "for developing cryo-electron microscopy for the high-resolution structure determination of biomolecules in solution."

**Timeline of scientific computing**

18th century

- 1733 - The French naturalist Comte de Buffon poses his needle problem.
- Euler comes up with a simple numerical method for integrands.

19th century

- First formulation of Gram-Schmidt orthogonalisation by Laplace, to be further improved decades later.
- Babbage in 1822, began work on a machine made to compute/calculate values of polynomial functions automatically by using the method of finite differences. This was eventually called the Difference engine.
- Lovelace's note G on the Analytical Engine (1842) describes an algorithm for generating Bernoulli numbers. It is considered the first algorithm ever specifically tailored for implementation on a computer, and thus the first-ever computer programme. The engine was never completed, however, so her code was never tested.
- Adams-Bashforth method published.
- In applied mathematics, Jacobi develops technique for solving numerical equations.
- To help with computing tides, Harmonic Analyser is built in 1886.
1900s (decade)


1910s (decade)

- 1910 - A-M Cholesky creates a matrix decomposition scheme.
- Richardson extrapolation introduced.

1920s

- 1922 - Lewis Fry Richardson introduces numerical weather forecasting by manual calculation, using methods originally developed by Vilhelm Bjerknes as early as 1895.
- 1926 - Grete Hermann publishes foundational paper for computer algebra, which established the existence of algorithms (including complexity bounds) for many of the basic problems of abstract algebra, such as ideal membership for polynomial rings.
- 1927 - Douglas Hartree creates what is later known as the Hartree–Fock method, the first ab initio quantum chemistry methods. However, manual solutions of the Hartree–Fock equations for a medium-sized atom were laborious and small molecules required computational resources far beyond what was available before 1950.

1930s

This decade marks the first major strides to a modern computer, and hence the start of the modern era.

- Fermi's Rome physics research group (informal name I ragazzi di Via Panisperna) develop statistical algorithms based on Comte de Buffon's work, that would later become the foundation of the Monte Carlo method. See also FERMIAC.
- Shannon explains how to use electric circuits to do Boolean algebra in "A Symbolic Analysis of Relay and Switching Circuits"
- John Vincent Atanasoff and Clifford Berry create the first electronic non-programmable, digital computing device, the Atanasoff–Berry Computer, from 1937-42.
- Complex number calculator created by Stibitz.
1940s

- 1947 - Monte Carlo simulation (voted one of the top 10 algorithms of the 20th century) invented at Los Alamos by von Neumann, Ulam and Metropolis.
- George Dantzig introduces the simplex method (voted one of the top 10 algorithms of the 20th century) in 1947.
- Ulam and von Neumann introduce the notion of cellular automata.
- Turing formulated the LU decomposition method.
- A. W. H. Phillips invents the MONIAC hydraulic computer at LSE, better known as "Phillips Hydraulic Computer".
- First hydro simulations occurred at Los Alamos.

1950s

- First successful weather predictions on a computer occurred.
- Hestenes, Stiefel, and Lanczos, all from the Institute for Numerical Analysis at the National Bureau of Standards, initiate the development of Krylov subspace iteration methods. Voted one of the top 10 algorithms of the 20th century.
- Equations of State Calculations by Fast Computing Machines introduces the Metropolis–Hastings algorithm.
- Molecular dynamics invented by Bernie Alder and Wainwright
- A S Householder invents his eponymous matrices and transformation method (voted one of the top 10 algorithms of the 20th century).
- A team led by John Backus develops the FORTRAN compiler and programming language at IBM's research centre in San Jose, California. This sped the adoption of scientific programming, and is one of the oldest extant programming languages, as well as one of the most popular in science and engineering.

1960s

- 1960 - First recorded use of the term "finite element method" by Ray Clough to describe the earlier methods of Richard Courant, Alexander Hrennikoff and Olgierd Zienkiewicz in structural analysis.
• 1961 - John G.F. Francis and Vera Kublanovskaya invent QR factorization (voted one of the top 10 algorithms of the 20th century).
• 1963 - Edward Lorenz discovers the butterfly effect on a computer, attracting interest in chaos theory.
• 1961 - Using computational investigations of the 3-body problem, Michael Minovitch formulates the gravity assist method.
• 1964 - Molecular dynamics invented independently by Aneesur Rahman.
• 1965 - Fast Fourier Transform developed by James W. Cooley and John W. Tukey.
• 1964 - Walter Kohn, with Lu Jeu Sham and Pierre Hohenberg, instigates the development of density functional theory, for which he shares the 1998 Nobel Chemistry Prize with John Pople. This contribution is arguably the earliest work to which Nobels were given for a computer program or computational technique.

1970s

• 1975 - Benoît Mandelbrot coins the term "fractal" to describe the self-similarity found in the Fatou, Julia and Mandelbrot sets. Fractals become the first mathematical visualization tool extensively explored with computing.
• 1977 - Kenneth Appel and Wolfgang Haken prove the four colour theorem, the first theorem to be proved by computer.

1980s

• Fast multipole method (voted one of the top 10 algorithms of the 20th century) invented by Vladimir Rokhlin and Leslie Greengard.
• Car–Parrinello molecular dynamics developed by Roberto Car and Michele Parrinello

1990s

• 1990 - In computational genomics and sequence analysis, the Human Genome Project, an endeavour to sequence the entire human genome, begins.
• 1998 - Kepler conjecture is almost all but certainly proved algorithmically by Thomas Hales.
• The appearance of the first research grids using volunteer computing - GIMPS (1996), distributed.net (1997) and Seti@Home (1999).
### Timeline of computational physics

**2000s**

- 2000 - The Human Genome Project completes a rough draft of human genome.
- 2003 - The Human Genome Project completed.
- 2002 - The BOINC architecture is launched in 2002.

**2010s**

- Foldit players solve virus structure, one of the first cases of a game solving a scientific question.

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**1930s**

- John Vincent Atanasoff and Clifford Berry create the first electronic non-programmable, digital computing device, the Atanasoff–Berry Computer, that lasted from 1937 to 1942.

**1940s**

- Nuclear bomb and ballistics simulations at Los Alamos and BRL, respectively.
- Monte Carlo simulation (voted one of the top 10 algorithms of the 20th century by Jack Dongarra and Francis Sullivan in the 2000 issue of Computing in Science and Engineering) is invented at Los Alamos by von Neumann, Ulam and Metropolis.
- First hydrodynamic simulations performed at Los Alamos.
- Ulam and von Neumann introduce the notion of cellular automata.

**1950s**

- *Equations of State Calculations by Fast Computing Machines* introduces the Metropolis–Hastings algorithm. Also, important earlier independent work by Alder and S. Frankel.
- Fermi, Ulam and Pasta with help from Mary Tsingou, discover the Fermi–Pasta–Ulam problem.
- Research initiated into percolation theory.
- Molecular dynamics is formulated by Alder and Wainwright.
1960s

- Using computational investigations of the 3-body problem, Minovitch formulates the gravity assist method.
- Glauber dynamics is invented for the Ising model.
- Edward Lorenz discovers the butterfly effect on a computer, attracting interest in chaos theory.
- Molecular dynamics is independently invented by Aneesur Rahman.
- W Kohn instigates the development of density functional theory (with LJ Sham and P Hohenberg), for which he shared the Nobel Chemistry Prize (1998).
- Kruskal and Zabusky follow up the Fermi–Pasta–Ulam problem with further numerical experiments, and coin the term "soliton".
- Kawasaki dynamics is invented for the Ising model.
- Frenchman Verlet (re)discovers a numerical integration algorithm, (first used in 1791 by Delambre, by Cowell and Crommelin in 1909, and by Carl Fredrik Störmer in 1907, hence the alternative names Störmer's method or the Verlet-Störmer method) for dynamics, and the Verlet list.

1970s

- Computer algebra replicates the work of Delaunay in Lunar theory.
- Veltman's calculations at CERN lead him and t'Hooft to valuable insights into Renormalizability of Electroweak theory. The computation has been cited as a key reason for the award of the Nobel prize that has been given to both.
- Hardy, Pomeau and de Pazzis introduce the first lattice gas model, abbreviated as the HPP model after its authors. These later evolved into lattice Boltzmann models.
- Wilson shows that continuum QCD is recovered for an infinitely large lattice with its sites infinitesimally close to one another, thereby beginning lattice QCD.

1980s

- Italian physicists Car and Parrinello invent the Car–Parrinello method.
- Swendsen–Wang algorithm is invented in the field of Monte Carlo simulations.
- Fast multipole method is invented by Rokhlin and Greengard (voted one of the top 10 algorithms of the 20th century).
- U. Wolff invents the Wolff algorithm for statistical physics and Monte Carlo simulation.
Timeline of the Manhattan Project

1939

- August 2: Albert Einstein signs the letter (Einstein–Szilárd letter), authored by physicist Leó Szilárd and addressed to President Franklin D. Roosevelt, advising him to fund research into the possibility of using nuclear fission as a weapon as Nazi Germany may also be conducting such research.
- September 3: Great Britain and France declare war on Nazi Germany in response to its invasion of Poland, beginning World War II.
- October 11: Economist Alexander Sachs meets with President Roosevelt and delivers the Einstein–Szilárd letter. Roosevelt authorizes the creation of the Advisory Committee on Uranium.
- October 21: First meeting of the Advisory Committee on Uranium, headed by Lyman Briggs of the National Bureau of Standards; $6,000 is budgeted for neutron experiments.

1940

- March 2: John R. Dunning’s team at Columbia University verifies Niels Bohr’s hypothesis that uranium 235 is responsible for fission by slow neutrons.
- March: University of Birmingham-based scientists Otto Frisch and Rudolf Peierls author the Frisch–Peierls memorandum, calculate that an atomic bomb might need as little as 1 pound (0.45 kg) of enriched uranium to work. The memorandum is given to Mark Oliphant, who in turn hands it over to Sir Henry Tizard.
- April 10: MAUD Committee established by Tizard to investigate feasibility of an atomic bomb.
- May 21: George Kistiakowsky suggests using gaseous diffusion as a means of isotope separation.
- June 12: Roosevelt creates the National Defense Research Committee (NDRC) under Vannevar Bush, which absorbs the Uranium Committee.
- September 6: Bush tells Briggs that the NDRC will provide $40,000 for the uranium project.

1941

- February 25: Conclusive discovery of plutonium by Glenn Seaborg and Arthur Wahl at the University of California, Berkeley.
- May 17: A report by Arthur Compton and the National Academy of Sciences is issued which finds favorable the prospects of developing nuclear power production for military use.
June 28: Roosevelt creates the Office of Scientific Research and Development (OSRD) under Vannevar Bush with the signing of Executive Order 8807. OSRD absorbs NDRC and the Uranium Committee. James B. Conant succeeds Bush as the head of NDRC.

July 2: The MAUD Committee chooses James Chadwick to write the second (and final) draft of its report on the design and costs of developing a bomb.

July 15: The MAUD Committee issues final detailed technical report on design and costs to develop a bomb. Advance copy sent to Vannevar Bush who decides to wait for official version before taking any action.

August: Mark Oliphant travels to USA to urge development of a bomb rather than power production.

September 3: British Chiefs of Staff Committee approve nuclear weapons project.


October 9: Bush takes MAUD Report to Roosevelt, who approves Project to confirm MAUD's findings. Roosevelt asks Bush to draft a letter so that the British government could be approached "at the top."

December 6: Bush holds a meeting to organize an accelerated research project, still managed by Arthur Compton. Harold Urey is assigned to develop research into gaseous diffusion as a uranium enrichment method, while Ernest O. Lawrence is assigned to investigate electromagnetic separation methods which resulted in the invention of Calutron. Compton puts the case for plutonium before Bush and Conant.

December 7: The Japanese attack Pearl Harbor. The United States and Great Britain issue a formal declaration of war against Japan the next day.

December 11: The same day after Germany and Italy declares war on the United States, the United States declares war on Germany and Italy.

December 18: First meeting of the OSRD sponsored S-1 Section, dedicated to developing nuclear weapons.

1942

January 19: Roosevelt formally authorizes the atomic bomb project.

January 24: Compton decides to centralize plutonium work at the University of Chicago.

June 19: S-1 Executive Committee is formed, consisting of Bush, Conant, Compton, Lawrence and Urey.

June 25: S-1 Executive Committee selects Stone & Webster as primary contractor for construction at the Tennessee site.

July–September: Physicist Robert Oppenheimer convenes a summer conference at the University of California, Berkeley to discuss the design of a fission bomb. Edward Teller brings up the possibility of a hydrogen bomb as a major point of discussion.
July 30: Sir John Anderson urges Prime Minister Winston Churchill to pursue a joint project with the United States.

August 13: The Manhattan Engineering District with James C. Marshall as District Engineer is established by the Chief of the United States Army Corps of Engineers, Major General Eugene Reybold, effective August 16.

September 17: Major General Wilhelm D. Styer and Reybold order Colonel Leslie Groves to take over the project.

September 23: Groves is promoted to brigadier general, and becomes director of the project. The Military Policy Committee, consisting of Bush (with Conant as his alternative), Styer and Rear Admiral William R. Purnell is created to oversee the project.

September 26: The Manhattan Project is given permission to use the highest wartime priority rating by the War Production Board.

September 29: Under Secretary of War Robert P. Patterson authorizes the Corps of Engineers to acquire 56,000 acres (23,000 ha) in Tennessee for Site X, which will become the Oak Ridge, Tennessee, laboratory and production site.

October 19: Groves appoints Oppenheimer to coordinate the scientific research of the project at the Site Y laboratory.

November 16: Groves and Oppenheimer visit Los Alamos, New Mexico and designate it as the location for Site Y.

December 2: Chicago Pile-1, the first nuclear reactor goes critical at the University of Chicago under the leadership and design of Enrico Fermi, achieving a self-sustaining reaction just one month after construction was started.

1943

January 16: Groves approves development of the Hanford Site.

February 9: Patterson approves acquisition of 400,000 acres (160,000 ha) at Hanford.

February 18: Construction begins for Y-12, a massive electromagnetic separation plant for enriching uranium at Oak Ridge.

April 1: Los Alamos laboratory is established.

April 5–14: Robert Serber delivers introductory lectures at Los Alamos, later are compiled into The Los Alamos Primer.

April 20: The University of California becomes the formal business manager of the Los Alamos laboratory.
- Mid-1943: The S-1 Committee was eliminated by mid-1943, as it had been superseded by the Military Policy Committee.
- June 2: Construction begins of K-25, the gaseous diffusion plant.
- July: The president proclaims Los Alamos, Clinton Engineer Works (CEW) and Hanford Engineer Works (HEW) as military districts. The Governor of Tennessee Prentice Cooper was officially handed the proclamation making Oak Ridge a military district not subject to state control by a junior officer (a lieutenant) he tore it up and refused to see the MED District Engineer Lt-Col James C. Marshall. The new District Engineer Kenneth Nichols had to placate him.
- July 10: First sample of plutonium arrives at Los Alamos.
- August 13: First drop test of gun-type fission weapon at Dahlgren Proving Ground under the direction of Norman F. Ramsey.
- August 13: Kenneth Nichols replaces Marshall as head of the Manhattan Engineer District. One of his first tasks as district engineer is to move the district headquarters to Oak Ridge, although its name did not change.
- August 19: Roosevelt and Churchill sign Quebec Agreement.
- September 8: First meeting of the Combined Policy Committee, established by the Quebec Agreement to coordinate the efforts of the United States, United Kingdom and Canada. United States Secretary of War Henry Stimson, Bush and Conant are the American members; Field Marshal Sir John Dill and Colonel J. J. Llewellyn are the British members, and C. D. Howe is the Canadian member.
- October 10: Construction begins for the first reactor at the Hanford Site.
- November 4: X-10 Graphite Reactor goes critical at Oak Ridge.

1944

- January 11: A special group of the Theoretical Division is created at Los Alamos under Edward Teller to study implosion.
- March 11: Beta calutrons commence operation at Oak Ridge.
- April 5: At Los Alamos, Emilio Segrè receives the first sample of reactor-bred plutonium from Oak Ridge, and within ten days discovers that the spontaneous fission rate is too high for use in a gun-type fission weapon (because of Pu-240 isotope present as an impurity in the Pu-239).
- May 9: The world's third reactor, LOPO, the first aqueous homogeneous reactor, and the first fueled by enriched uranium, goes critical at Los Alamos.
July 4: Oppenheimer reveals Segrè's final measurements to the Los Alamos staff, and the development of the gun-type plutonium weapon "Thin Man" is abandoned. Designing a workable implosion design (Fat Man) becomes the top priority of the laboratory, and design of the uranium gun-type weapon (Little Boy) continued.

July 20: The Los Alamos organizational structure is completely changed to reflect the new priority.

September 2: Two chemists are killed, and Arnold Kramish almost killed, after being sprayed with highly corrosive hydrofluoric acid while attempting to unclog a uranium enrichment device which is part of the pilot thermal diffusion plant at the Philadelphia Navy Yard.

September 22: First RaLa test with a radioactive source performed at Los Alamos.

September 26: The largest nuclear reactor, the B reactor, goes critical at the Hanford Site.

Late November: Samuel Goudsmit, scientific head of the Alsos Mission, concludes, based on papers recovered in Strasbourg, that the Germans did not make substantial progress towards an atomic bomb or nuclear reactor, and that the programs were not even considered high priority.

December 14: Definite evidence of achievable compression obtained in a RaLa test.

December 17: 509th Composite Group formed under Colonel Paul W. Tibbets to deliver the bomb.

1945

January: Brigadier General Thomas Farrell is named Groves' deputy.

January 7: First RaLa test using exploding-bridgewire detonators.

January 20: First stages of K-25 are charged with uranium hexafluoride gas.

February 2: First Hanford plutonium arrives at Los Alamos.

April 22: Alsos Mission captures German experimental nuclear reactor at Haigerloch.

April 27: First meeting of the Target Committee.

May 7: Nazi Germany formally surrenders to Allied powers, marking the end of World War II in Europe; 100-ton test explosion at Alamogordo, New Mexico.

May 10: Second meeting of the Target Committee, at Los Alamos.

May 28: Third meeting which works to finalize the list of cities on which atomic bombs may be dropped: Kokura, Hiroshima, Niigata and Kyoto.

May 30: Stimson drops Kyoto from the target list.

June 11: Metallurgical Laboratory scientists under James Franck issue the Franck Report arguing for a demonstration of the bomb before using it against civilian targets.
July 16: the first nuclear explosion, the Trinity nuclear test of an implosion-style plutonium-based nuclear weapon known as the gadget at Alamogordo; USS Indianapolis sails for Tinian with nuclear components on board.

July 19: Oppenheimer recommends to Groves that gun-type design be abandoned and the uranium-235 used to make composite cores.

July 24: President Harry S. Truman discloses to Soviet leader Joseph Stalin that the United States has atomic weapons. Stalin feigns little surprise; he already knows this through espionage.

July 25: General Carl Spaatz is ordered to bomb one of the targets: Hiroshima, Kokura, Niigata or Nagasaki as soon as weather permitted, some time after August 3.

July 26: Potsdam Declaration is issued, threatening Japan with "prompt and utter destruction".

August 6: B-29 Enola Gay drops Little Boy, a gun-type uranium-235 weapon, on the city of Hiroshima, the primary target.

August 9: B-29 Bockscar drops a Fat Man implosion-type plutonium weapon on the city of Nagasaki, the secondary target, as the primary, Kokura, is obscured by cloud and smoke.

August 12: The Smyth Report is released to the public, giving the first technical history of the development of the first atomic bombs.

August 14: Surrender of Japan to the Allied powers.

August 21: Harry Daghlian, a physicist, receives a fatal dose (510 rems) of radiation from a criticality accident when he accidentally dropped a tungsten carbide brick onto a plutonium bomb core. He dies on September 15.

September 4: Manhattan District orders shutdown of S-50 liquid thermal diffusion plant and the Y-12 Alpha plant.

September 8: Manhattan Project survey group under Farrell arrives in Nagasaki.

September 17: Survey group under Colonel Stafford L. Warren arrives in Nagasaki.

September 22: Last Y-12 alpha track ceases operating.

October 16: Oppenheimer resigns as director of Los Alamos, and is succeeded by Norris Bradbury the next day.

1946

February: News of the Russian spy ring in Canada exposed by defector Igor Gouzenko is made public, creating a mild "atomic spy" hysteria, pushing American Congressional discussions about postwar atomic regulation in a more conservative direction.
May 21: Physicist Louis Slotin receives a fatal dose of radiation (2100 rems) when the screwdriver he was using to keep two beryllium hemispheres apart slips.

July 1: Able test at Bikini Atoll as part of Operation Crossroads.


August 1: Truman signs the Atomic Energy Act of 1946 into law, ending almost a year of uncertainty about the control of atomic research in the postwar United States.

1947

January 1: the Atomic Energy Act of 1946 (known as the McMahon Act) takes effect, and the Manhattan Project is officially turned over to the United States Atomic Energy Commission.

August 15: Manhattan District is abolished.

Timeline of particle physics technology

- 1896 - Charles Wilson discovers that energetic particles produce droplet tracks in supersaturated gases
- 1897-1901 - Discovery of the Townsend discharge by John Sealy Townsend
- 1908 - Hans Geiger and Ernest Rutherford use the Townsend discharge principle to detect alpha particles.
- 1911 - Charles Wilson finishes a sophisticated cloud chamber
- 1928 - Hans Geiger and Walther Muller invent the Geiger Muller tube, which is based upon the gas ionisation principle used by Geiger in 1908, but is a practical device that can also detect beta and gamma radiation. This is implicitly also the invention of the Geiger Muller counter.
- 1934 - Ernest Lawrence and Stan Livingston invent the cyclotron
- 1945 - Edwin McMillan devises a synchrotron
- 1952 - Donald Glaser develops the bubble chamber
- 1968 - Georges Charpak and Roger Bouclier build the first multiwire proportional mode particle detection chamber

Timeline of automobiles
1860

Thomas Rickett's steam-powered car was particularly notable in the history of motor vehicle production inasmuch as several examples were made, and it was also advertised.

UK. Steam: Rickett

1861

US. Steam: Ware Steam Wagon

1873

The Bollée family played a significant part in the history of motor vehicle manufacture; the father with his steam car, and one of his sons, in 1895, with an internal-combustion engine design.

France. Steam bus: Amédée Bollée

1883

France. Steam: De Dion-Bouton (later internal-combustion, with a patent in 1889)

1884

France. Internal-combustion: Delamare-Deboutteville

1885

Karl Benz's vehicle was the first true automobile, entirely designed as such, rather than simply being a motorized stage coach or horse carriage. This is why he was granted his patent, and is regarded as its inventor. His wife and sons became the first true motorists, in 1889, when they took the car out for the specific task of paying a family visit.

Germany. Internal-combustion: Benz

UK. Internal-combustion: Butler

Austria-Hungary. Internal-combustion: Laurin & Klement (later Skoda)

US. Electric: Armstrong Electric
1886


1887

UK. Motorcycle: New Imperial

1889

The first Daimler car was a converted carriage, but with innovations that are still adopted today (cushioned engine mountings, fan cooling, finned-radiator water cooling).

France. Steam: Peugeot (later internal-combustion, and the first to be entered in an organised race, albeit for bicycles, Paris–Brest–Paris)

Germany. Internal-combustion: Daimler (DMG)

UK. Internal-combustion: Santler

US. Internal-combustion rotary engine: Adams-Farwell

1890

Panhard and Levassor’s design of a front-mounted engine established the layout of the majority of cars since then.

France. Internal-combustion: Panhard-Levassor

1891

US. Steam: Black; steam tractor: Avery; internal-combustion: Buckeye gasoline buggy

1893

France. Electric (and later internal-combustion): Jeantaud

UK. Steam: Straker-Squire (also known as Brazil Straker)

US. Internal-combustion: Elmore, Durveya
1894

France. Internal-combustion: Audibert & Lavirotte, Berliet, Delahaye

UK. Electric: Garrard & Blumfield

US. Electric: Electrobat

1895

France. Internal-combustion: Léon Bollée, Corre, Rochet-Schneider

UK. Internal-combustion: Knight, Lanchester

US. Electric: Morris & Salom

US. Internal-combustion: De La Vergne

1896

In the UK, the Locomotives on Highways Act 1896 replaced the hugely restrictive Locomotive Acts of 1861, 1865 and 1878 (the so-called Red Flag acts) thereby finally freeing up the automotive industry in the UK (and, incidentally, was also the origin of the celebrations of the first London to Brighton Veteran Car Run). Knight had been convicted under the old act, the previous year, for not having a man precede his vehicle with a red flag, and Walter Arnold was the first person to be convicted, in January 1896, for exceeding the speed limit. Meanwhile, Serpollet was issued with what was effectively the first driving licence.

France. Steam: Gardner-Serpollet; internal-combustion: Clément-Gladiator, Dalifol, Darracq, Lorraine-Dietrich, Triouleyre; voiturette: Dalifol & Thomas, Goujon, Léon Bollée; motorcycle: Clément and Gladiator

Italy. Internal-combustion: Enrico Bernardi

Russia. Internal-combustion: Yakovlev-Frese


US. Internal-combustion: Altham, Black, Electric & internal-combustion: Brewster, Haynes-Apperson
1897

France. Steam: Montier & Gillet; electric: Krieger; internal-combustion: Grivel, Juzan, Société Parisienne, Mors; voiturette: Decauville, Richard; avant-train: Amiot

UK. Steam: Toward & Philipson; Electric: Bushbury Electric, Neale; electric phaeton: Electric Motive Power; internal-combustion: Belsize; bus: Thomas Harrington

US. Electric: Pope; Internal-combustion: Autocar, Oldsmobile, Plass, Winton

Austria-Hungary. Internal-combustion: Präsident (Tatra)

1898

Belgium. Internal-combustion: Delecroix, Métallurgique


Germany. Electric: Kühlstein; internal-combustion: AWE, Wartburg

Italy. Internal-combustion: Ceirano GB & C; motor tricycle/quadricycle: Prinetti & Stucchi


US. Steam: American Waltham; electric: Riker; internal-combustion: Rutenber, St. Louis; buggy: Stearns

1899

Belgium. Voiturette: Vivinus


Germany. Internal-combustion: Opel

Italy. Internal-combustion: Fiat

Russia. Electric: Kukushka
UK. Electric: Joel-Rosenthal; internal-combustion: Accles-Turrell, Geering; voiturette: Argyll; motor tricycle/quadricycle: Allard, Anglo-American; motorcycle: Coventry-Eagle, OK-Supreme, Quadrant, Royal Enfield


1900

Belgium. Hybrid: Pieper; internal-combustion: Nagant, Pipe; voiturette: Antoine

Canada. Electric: Canadian Motor

France. Internal-combustion: Ader, Ardent, Chenard-Walcker, Maillard, Nanceene, Otto; voiturette: Chainless, Soncin; motorcycle: Buchet, Castoldi

Germany. Internal-combustion: Adler, Albion; voiturette: AGG; motorcycle (later trucks): Phänomen

Italy. Internal-combustion: Isotta Fraschini

UK. Internal-combustion: Hewinson-Bell, Napier, Smith & Dowse; voiturette: Billings-Burns; motorcycle: Rex-Acme

US. Steam: Tractobile, Kent's Pacemaker, Porter Stanhope, Skene, Steamobile; electric: Hewitt-Lindstrom, National; internal-combustion: Auburn, Canda, California, Eureka, Holley, Keystone, Knox, Lozier, Peerless, Rambler, Stearns-Knight; tractor: Samson; truck: Detroit

1901

Canada. Light car: Queen

France. Internal-combustion: Charron, Corre La Licorne; voiturette: L'Ardennais, Guerraz, Henry-Dubray, Korn et Latil, Malliary; light car: Denis de Boisse

Germany. Internal-combustion: Horch, Stoewer; motorcycle: NSU
UK. Electric: Electromobile; internal-combustion: Asquith, Imperial, John O'Gaunt, Sunbeam, paraffin fuelled: Ralph Lucas; cyclecar: Campion; light car: Ralph Gilbert; voiturette: Wolseley; motorcycle: Matchless, Singer

US. Steam: Aultman, Binney & Burnham, Covert, Desberon, Hidley, Hudson, Reading Steamer, Stearns, White; internal-combustion: Altman, Apperson, Buffalo, Buffum, De Dion, Empire, Marion, Pierce-Arrow, Schaum; touring car: Austin; runabout: Stevens-Duryea; high wheeler: Holsman; motorcycle: Indian

1902

Belgium. Internal-combustion: Minerva

France. Internal-combustion: Motobloc, Richard-Brasier

Germany. Internal-combustion: Aachener, AEG, Argus, Beaufort, NAG; motorised tricycle/quadricycle: Cyklon

Russia. Electric: Dux

Spain. Internal-combustion: Anglada

UK. Steam: Vapomobile; internal-combustion: Abingdon, Armstrong, Karminski, Maudslay, Rover, Vulcan; voiturette: Esculapeus, tricar: Advance; motorcycle: Norton, Triumph

US. Steam: Clipper, Hoffman, Richmond, Stanley; electric: Studebaker; internal-combustion: Blood, Brennan, Cadillac, Cameron, Cannon, Clarkmobile, Franklin (automobile), Gaeth, Hammer-Sommer, Kirk, Marmon, Reber; runabout: Glide (automobile), Smith, Standard Steel; touring car: Spaulding; light car: Greenleaf, Orient; buggy: American, Union; compound expansion: Eisenhuth; truck: Rapid

1903

Belgium. Internal-combustion: Excelsior

France. Internal-combustion: Ariès, Clément-Bayard, Delaunay-Belleville, Hotchkiss, Regal, Talbot; light car: Henry Bauchet

Germany. Internal-combustion bus/truck: Büssing


1904

Canada. Internal-combustion: Russell

France. Internal-combustion: Cottin & Desgouttes, Grégoire; voiturette: Lavie; motor tricycle: La Va Bon Train

Germany. Internal-combustion: Alliance, Wenkelmobil

Italy. Internal-combustion: Italia

Spain. Internal-combustion: Hispano-Suiza

UK. Electric: Imperial; internal-combustion: Arbee, Armstrong, Whitworth, Ascot, Calthorpe, Chambers, Crossley, Croxted, Iden, Motor Carrier, Queen; voiturette: Achilles; light car: Gilburt; tricar: Garrard; motorcycle: Phelon & Moore, Zenith

US. Steam: Empire Steamer; electric: Berwick, Marquette; internal-combustion: American, American Mercedes, American Napier, Christie, Cleveland, Corbin, Detroit, Wheeler, Dolson, Lambert, Luverne, Maxwell, Moline, Orlo, Oscar Lear, Pierce-Racine, Queen, Sampson, Schacht, Sinclair-Scott (Maryland), Standard, Studebaker-Garford, Twyford Stanhope; touring car: Brew-Hatcher, Crane-Simplex, Crestmobile, Detroit Auto, Frayer-Miller, Jeffery, Pungs, Finch, Richmond, Royal, Thomas, Upton; runabout: Courier, Fredonia, Northern, Pierce, Pope-Tribune; tractor: Holt

1905

France. Internal-combustion: Alliance, Brasier, Charlon, Couverchel, Delage, Eudelin, Rolland-Pilain, Sizaire-Naudin; touring car: Rebour; light car: Helbé, Urrie; voiturette: Eureka; motorcycle: Herdtle & Bruneau

Germany. Steam: Altmann; internal-combustion: Ehrhardt, Hansa, Hexe, Solidor

Italy. Internal-combustion: Diatto, Zust

UK. Electric: Alexandra, Ekstromer; internal-combustion: Adams, Austin, Edismith, Riley, Sunbeam-Talbot, Talbot; light car: One of the Best; tricar: Anglian; motorcycle: Velocette

1906

Belgium. Internal-combustion: Imperia; hybrid: Auto-Mixte

France. Internal-combustion: AM, Ampère, Antoinette, Lion-Peugeot, Unic; light car: Doriot, Flandrin & Parant; voiturette and motorcycle: Alcyon

Germany. Internal-combustion: AAG

Italy. Internal-combustion: Aquila Italiana, Fial, Peugeot-Croizat, SCAT, SPA, Standard

UK. Internal-combustion: All-British, Ladas, Marlborough, Rolls-Royce; light car: Jowett; tricar: Addison, Armadale; dual-control car: Academy; hybrid bus: Tilling-Stevens; motorcycle: Dot

US. Steam: Doble, Ross; electric: Babcock; internal-combustion: ALCO, American, American Simplex, Apollo, Atlas, Bliss, Car de Luxe, Deere, Dorris, Dragon, Frontenac, Hol-Tan, Jewell, Kissel, Model, Moore (Ball-Bearing Car); touring car: Heine-Velox, Moon; roadster: Colburn; light car: Janney; high wheeler: ABC, Black, McIntyre, Success

1907

Belgium. Internal-combustion: Springuel

Canada. Internal-combustion: McLaughlin

France. Internal-combustion: Ariane, Jean-Bart, Lahaussois, Lutier, Marie de Bagneux, Prod'homme, Sinpar, Sixcyl; voiturette: Couteret, Obus, La Radieuse; voiturette tricar: Guerry et Bourguignon, Lurquin-Coudert; tricar: Austral, Mototri Contal; hybrid: AL; amphibious: Ravailler; racing car: De Bazelaire

UK. Internal-combustion: Dalgliesh-Gullane, Hillman; truck: Commer; motorcycle: Douglas

1908

France. Internal-combustion: Le Pratic, X; phaeton: Siscart; voiturette: Roussel

Germany. Internal-combustion: Allright, Brennabor, Fafnir, Lloyd

Italy. Internal-combustion: Lancia, Marca-Tre-Spade, Temperino

Russia. Internal-combustion: Russo-Balt

UK. Internal-combustion: Arno, Sheffield-Simplex, Valveless; touring car: Argon; light car: Alex; motorcycle: Premier

US. Internal-combustion: Bendix, Coates-Goshen, Correja, Cunningham, De Luxe, General Motors, Gyroscope, Havers, Imperial, Paige, Sears, Velie; touring car: Moyer; high wheeler: Cole, De Schaum, DeWitt, Hobbie Accessible, Michigan; runabout: Simplo; cyclecar: Browniekar; buggy: Davis

1909

France. Internal-combustion: Bugatti, FL, La Ponette, Le Zèbre

Italy. Racing car: Brixia-Zust; motorcycle: Della Ferrera

Netherlands. Internal-combustion: Entrop

UK. Internal-combustion: Pilot

US. Internal-combustion: Abbott-Detroit, Anhut, Black Crow, Crow-Elkhart, Cutting, EMF, Everitt, Fuller, GJG, Hupmobile, Inter-State, Lion, Pilot; touring car: Crawford, Fal-Car, Piggins, Standard Six; roadster: Coyote, Hudson, Kauffman; runabout: Brush; small car: Herreshoff, Hitchcock, KRIT; light car: Courier; buggy: Paterson; raceabout: Mercer; racing car: McFarlan; truck: Chase, Sanford-Herbert

1910

Canada. Internal-combustion: Gareau

France. Internal-combustion: Ageron, Damaizin & Pujos, Margaria, Mathis, Plasson; light car: Simplicia; cyclecar: Bédélia

Germany. Internal-combustion: Ansbach, Apollo, Audi
Italy. Internal-combustion: Alfa Romeo, Chiribiri

UK. Steam: AMC; internal-combustion: Morgan, Siddeley-Deasy; cyclecar: GN


1911

Canada. Internal-combustion: Clinton

France. Cyclecar: Enders

Germany. Internal-combustion: Excelsior-Mascot, Podeus; rotary valve: Standard

Italy. Motorcycle: Benelli

UK. Internal-combustion: Aberdonia, AGR, Airedale, GWK, Newton-Bennett, Roper-Corbet; cyclecar: Alvechurch, Autotrix, Lambert; motorcycle: Beardmore, Coventry-Victor, Leviis, Rudge-Whitworth, Villiers


1912

Canada. Internal-combustion: Amherst


Hungary. Internal-combustion: Raba

Italy. Internal-combustion: Storero

Spain. Internal-combustion: Abadal
UK. Steam: Sheppee; internal-combustion: ABC; cyclecar: Adamson, Arden, Chota, Coventry Premier, Crouch, Hampton, HCE, Tiny, Tyseley; motorcycle: NUT, Sunbeam

US. Electric: Argo Electric, Buffalo Electric, Church-Field; internal-combustion: Anna, Briggs-Detroiter, Crane & Breed, Pathfinder, Standard; touring car: Miller, Westcott; light-car: Lad's Car, Little; tricar: American Tri-Car, motorcycle: Cyclone; truck: Brockway, Palmer-Moore

1913

Belgium. Internal-combustion: Alatac

France. Internal-combustion: Ajax, Alba, Alva, Rougier; cyclecar: Jouvie

Spain. Cyclecar: David


US. Electric: American Electric; internal-combustion: Allen (Ohio), Allen (Philadelphia), Chandler, Flyer, Grant, Lyons-Knight, Monarch; cyclecar: Car-Nation, Coey, Detroit Cyclecar, Downing-Detroit, Dudly Bug, Gadabout, JPL, Little Detroit Speedster, Little Princess, Twombly; touring car: Keeton; roadster: Saxon, Scripps-Booth; sports car: Duesenberg; motocycle: Bi-Autogo

1914

France. Internal-combustion: Ascot, Donnet-Zedel; light car: Nardini

Japan. Internal-combustion: DAT

Italy. Maserati

UK. Internal-combustion: Trojan, Utopian; light car: Bifort, cyclecar: Bradwell, Buckingham, Carden, Hill & Stanier, Imperial, Projecta, Simplic; motocycle: ABC

cyclecar: Argo, Arrow, Biesel, CAC, Cricket, Davis, Dodge, Engler, Excel, Hawk, Logan, LuLu, Malcolm Jones, Mercury, Motor Bob, O-We-Go, Xenia

1915

Canada. Internal-combustion: Gray-Dort, Regal

UK. Internal-combustion: Atalanta; sports car: Aston Martin


1916

Russia: AMO


Germany: BMW

1917

Canada. Internal-combustion: Moose Jaw Standard

UK. Cyclecar: Gibbons


1918

Italy: trucks OM

UK. Internal-combustion: All British Ford; motorcycle: Cotton

US. Steam: Bryan, internal-combustion: Essex; motorcycle: Ner-a-Car
1919

France. Internal-combustion: Avions Voisin, Butterosi, Citroen, Leyat, Salmsen; cyclecar: ASS, Soriano-Pedroso

Germany. Internal-combustion: AGA, Anker


US. Internal-combustion: Amco, Argonne, Climber, Du Pont, Graham-Paige; truck: Huffman

1920

Belgium. Light car: ALP

France. Electric: Electricar; internal-combustion: Janémian, Jouffret, Radior; cyclecar: Able, Ajams, Astatic, La Comfortable, De Marçay, Elfè, Kevah, Santax; sports car: Fonlupt

Germany. Internal-combustion: Joswin, Selve; touring car: Steiger

Japan: Mazda

UK. Internal-combustion: Aeroford, Cubitt, Galloway, Palmerston, Payze; light car: Albert; cyclecar: Allwyn, Archer, Baughan, Bell, Black Prince, Blériot-Whippet, Bound, Cambro, CFB, Winson; sports car: Sports Junior

USA: Ace, Alsace, Aluminum, Astra, Binghamton Electric, Carroll, Colonial, Colonial/Shaw, Friend, Gardner, Gray Light Car, LaFayette, Lorraine, Mason Truck, Sheridan, Standard Steam Car, Stanwood

1921

Canada: Brock Six, London Six

France: Amilcar, Ballot, Bernardet, Coadou et Fleury, Colda, Le Favori, Georges Irat, Hinstin, Janoir, Madoz, Quo Vadis, Le Roitelet, Solanet

Germany: Alfi, Arimofa, Atlantic, Pawi, Rumpler Tropfenwagen, Zündapp

Italy: Ansaldo, Aurea, IENA, motorcycle: Moto Guzzi

Japan: Ales
UK: Amazon, Barnard, Scott Sociable, Skeoch

US. Steam: Coats, Davis, internal combustion: Adria, Aero Car, Ajax, Automatic, Birmingham, Colonial, Davis Totem, Durant, Earl, Handley-Knight, Jacquet Flyer, Kessler, Wills Sainte Claire

1922

Canada: Colonial

France: Astra, Bucciali, Induco, JG, Vaillant

Germany: Juho, Komet

UK: Abbey, Abingdon, Albatros, Alberford, Aster, Atomette, Autogear, Baby Blake, Bean, Bow-V-Car, Christchurch-Campbell, Clyno, Frazer Nash, Gwynne, Packman & Poppe, Wigan-Barlow, Xtra


1923

Belgium: ADK, De Wandre, Juwel

Canada. Steam: Brooks

France: Bell, Henou, Willème

Germany: Alan, Kenter, Pilot, motorcycle: BMW

UK: Astral, Urecar

USA: Flint, Rugby

1924

Czech Republic: Skoda

France: AEM, AS, Le Cabri, De Sanzy, Elgé, Jean Gras, Jousset

Germany: Amor, Ehrhardt-Szawe, Tempo

Japan: Otomo
UK: HRD, Morris, Paydell

US. Steam: American; internal-combustion: Chrysler, Junior R, Pennant

1925

Belgium: Jeeey-Vea

France: Heinis, Jack Sport

Germany: Hanomag, Sablatnig-Beuchelt, Seidel-Arop

Italy: Amilcar Italiana, Maggiora, Moretti

UK: Brocklebank, Invicta, Jappic, McEvoy, MG

USA: Empire Steam Car, Ajax, Diana

1926

France: Alma, Arzac, Chaigneau-Brasier, Constantinesco, Lambert, Ratier, SAFAF, Sensaud de Lavaud, Tracta

Germany: Daimler-Benz, Gutbrod, Mercedes-Benz

UK: Arab, HP, Marendaz, Swallow

USA: Ansted, Divco, Dodgeson

1927

France: Rosengart, Silva-Coroner

UK: Arrol-Aster, Avro, Streamline (Burney Car)

USA: Falcon-Knight, Graham-Paige, LaSalle

Sweden: Volvo

1928

Germany: BMW, DKW
UK: Ascot, Vincent

USA: DeSoto, Plymouth

1929

France: Alphi, Michel Irat

Germany: Borgward

Italy: Ferrari

Soviet Union: Motorcycle: Izh

Spain: National Pescara

UK: Alta

USA: American Austin, Blackhawk, Cord, Roosevelt, Ruxton, Viking, Windsor

1930

Belgium: Astra

France: AER, Virus

Germany: Ardie-Ganz

Soviet Union: KIM

1931

Germany: Maikäfer

Soviet Union: ZIS

Japan: Datsun

UK: Squire

USA: De Vaux, Hoffman (Detroit automobile)
1932

Italy: Nardi

Poland: Polski Fiat

Soviet Union: GAZ

UK: Vale Special

USA: Allied, De Vaux Continental, Jaeger

1933

France: Tracford

Germany: Standard Superior

UK: André, Railton

USA: Continental

1934

France: Simca

Germany: Auto Union, Bungartz Butz

Japan: Ohta Jidosha

UK: Aveling-Barford, British Salmson, Rytecraft

1935

France: Talbot-Lago

Germany: Henschel

UK: Autovia, Batten, Jensen, Reliant

USA: Stout Scarab
1936

France: Darl'mat, Monocar
UK: Allard, HRG, Lammas, Lloyd, Skirrow

1937

France: Ardex, Danvignes
Germany: Volkswagen
UK: Atalanta

1938

France: DB, Rolux
UK: Nuffield

1939

Soviet Union: SMZ
USA: Albatross, Crosley, truck: Peterbilt

1940

UK: DMW

1941

Soviet Union: UAZ; motorcycle: IMZ-Ural

1942

Brazil. Trucks: F.N.M.

1943

Soviet Union. Trucks: Ural
1945

Soviet Union. Motorcycle: Dnipro

UK: Bristol, Healey

USA: Kaiser-Frazer

1946

France: Chappe et Gessalin, Mochet, Rovin

Germany: Messerschmitt

Hungary: Csepel

Italy: Bandini, Cisitalia, Stanguellini; Trucks: Astra

Soviet Union: Moskvitch; motorcycle: ZiD

Spain: Pegaso

UK: Cooper

USA: American Motors Incorporated, Frazer

1947

Canada: Studebaker

France: Aerocarene, Alamagny

Italy: Innocenti, Lambretta, Maserati, O.S.C.A.

Soviet Union. Trucks: Minsk Automobile Plant

UK: Ambassador, Ausföd, Buckler

USA: Airscoot, Davis, Playboy

1948

France: J-P Wimille
Germany: Fend Flitzer

Italy: Fimer, Iso Rivolta, Siata

Japan: Motorcycle: Marusho

Soviet Union: Trucks: BelAZ

UK: EMC, Land Rover, Rochdale, Thundersley Invacar

USA: Autoette, Keller, Tucker Sedan

1949

France: Atlas

India: AUTOPRD

Soviet Union: RAF

Japan: Motorcycle: Honda

UK: Dellow, Jaguar Cars

USA: Aerocar, Airway, Glasspar G2; scooter: PMC

1950

France: Autobleu

Germany: Fuldamobil, Kersting-Modellbauwerkstätten, Kleinschnittger, Staunau

Spain: SEAT

UK: Marauder, Paramount

USA: Muntz

1951

France: Atlas, Automobiles Marathon, Le Piaf, Reyonnah

Germany: Glas
Poland: FSO

Soviet Union. Trucks: KAZ; motorcycle: Minsk

UK: Arnott, Russon, Turner

USA: Nash-Healey

1952

France: Martin-Spéciale, Poinard

Germany: Brütsch, Champion

Soviet Union: PAZ

UK: Austin-Healey, BMC, Greeves, Lotus

USA: Allstate, Woodill

1953

Germany: EMW

USA: Eshelman, Fina-Sport

1954

France: Alpine, Facel Vega

Spain: Serveta

UK: Astra, Fairthorpe, Rodley, Swallow Doretti

USA: AMC, Studebaker-Packard

1955

Belgium: Meeussen

France: Saviem, VELAM
Germany: Goggomobil, Zwickau

Italy: Autobianchi

Soviet Union: LAZ, LuAZ

UK: Ashley, Elva

USA: Tri5's

1956

France: Arista

Germany: Heinkel Kabine

Soviet Union: ZiL, KAG; scooter: TMZ, Vyatka

UK: Berkeley, Tourette

USA: Auto Cub, Devin, Dual-Ghia

1957

France: Arbel, Atla

Germany: Neckar, Trabant

UK: Peerless (Warwick), Scootacar, Tornado

USA: Aurora, Hackney

1958

Soviet Union: KAvZ; trucks: BAZ, KrAZ

UK: Gill, Frisky

USA: Edsel, Streco Turnpike Cruiser
1959

India: Vehicle Factory Jabalpur

Soviet Union: LiAZ

UK: Bristol Siddeley, Gilbern, Marcos

USA: Argonaut, Nu-Klea Starlite

1960

India: Ideal Jawa

UK: Ausper, Brabham, Rickman

US. Replica veteran car: Gaslight

1961

Germany: Amphicar

Soviet Union: ZAZ

UK: Diva

1962

Canada: Acadian

France: Automobiles René Bonnet

Soviet Union: AvtoKuban

Japan. Motorcycle: Kawasaki

USA: Apollo

1963

Italy: ATS, Scuderia Serenissima, Lamborghini
UK: Bond, Gordon-Keeble

USA: Exner Revival Cars; trucks: Marmon

1964

Italy: ASA

Soviet Union: ErAZ

USA: Fiberfab

1965

France: Matra

India: Heavy Vehicles Factory

Italy: Ferves

Soviet Union: IzhAvto

Spain: IPV

UK: Jago, Peel

1966

Bulgaria: Bulgarrenault

Italy: Bizzarrini

Soviet Union: Lada; trucks: MoAZ

Romania: Dacia

UK: Norton-Villiers, Trident, Unipower

1967

India: TATA MOTORS
1968

Italy: Autozodiaco, LMX Sirex

Turkey: Tofaş

UK: Piper

USA: Savage GT

1969

Soviet Union. Trucks: Kamaz

UK: Enfield

Timeline of transportation technology

Antiquity

- 20th millennium BCE – rafts used on rivers.
- 7th millennium BCE – Earliest known shoes.
- 6th millennium BCE – Dugout canoes constructed.
- 4th millennium BCE – The earliest vehicles may have been ox carts.
- 3500 BCE – Domestication of the horse and invention of the wheel in Ancient Near East
- Toys excavated from the Indus valley civilization (3010–1500 BCE) include small carts.
- 3000 BCE – Austronesians construct catamarans and outriggers.
  - In the Mediterranean, galleys were developed about 3000 BC.
- 2nd millennium BCE – Cart mentioned in literature, chariot and spoked wheel invented.
- 800 BCE – Canal for transport constructed in Ancient China.
- 408 BCE – Wheelbarrow referenced in Ancient Greece.
Middle Ages

- 5th Century – Horse collar invented in China.
- 6th Century - Evidence of a horseshoe in the tomb of the Frankish King Childeric I, Tournai, Belgium.
- 800 – The streets of Baghdad are paved with tar.
- 9th century - The sine quadrant, was invented by Muhammad ibn Musa al-Khwarizmi in the 9th century at the House of Wisdom in Baghdad. The other types were the universal quadrant, the horary quadrant and the astrolabe quadrant.
- 10th Century – sea-going ships built in China.
- Late 10th century – Kamal invented in Arab world.
- 1044 – Compass invented in China.
- 13th century (or before) – Rocket invented in China.
- 1350 – Compass dial invented by Ibn al-Shatir.
- 1479-1519 - Da Vinci sketches pedalo.
- 15th century – Jan Žižka built the precursor to the motorised tank, armoured wagons equipped with cannons.
- 1569 - Mercator 1569 world map published.
- Late 16th century – European sailing ships become advanced enough to reliably cross oceans.

17th century

- 1620 – Cornelius Drebbel builds the world's first known submarine, which is propelled by oars (although there are earlier ideas for and depictions of submarines).
- 1662 – Blaise Pascal invents a horse-drawn public bus which has a regular route, schedule, and fare system.
- 1672 – Ferdinand Verbiest has built what may have been the first steam-powered scale model car.

18th century

- 1716 – Swedish scientist, Emanuel Swedenborg, creates the first concept of a hovering vehicle.
- 1731 - Sextant first implemented to accurately determine latitude.
- 1740 – Jacques de Vaucanson debuted his clockwork powered carriage.
- 1761 - Marine chronometer invented as a means to accurately determine longitude.
• 1769 – Nicolas-Joseph Cugnot demonstrates his *fardier à vapeur*, an experimental steam-driven artillery tractor

• 1776 – First submarine to be propelled by screws, and the first military submarine to attempt an attack on a ship, *Turtle*, is built by David Bushnell. The attack fails to sink HMS *Eagle*.

• 1783 - First parachute.

• 1783 – Joseph Montgolfier and Étienne Montgolfier launch the first hot air balloons.


• 1784 – William Murdoch built a working model of a steam locomotive carriage in Redruth, England.

• 1790s – Canal Mania, an intense period of canal building in England and Wales.

19th century

Early 19th century

• 1801 – Richard Trevithick ran a full-sized steam 'road locomotive' on the road in Camborne, England.

• 1803 – Richard Trevithick built his 10-seater London Steam Carriage.

• 1803 – William Symington's *Charlotte Dundas*, generally considered to be the world's first practical steamboat, makes her first voyage.

• 1804 – Richard Trevithick built a prototype steam-powered railway locomotive and it ran on the Pen-y-Darren Line near Merthyr Tydfil Wales.

• 1804 – Oliver Evans (claimed to have) demonstrated a steam-powered amphibious vehicle.

• 1807 - The Swansea and Mumbles Railway ran the world's first passenger horsecar tram service.

• 1807 – Robert Fulton's *North River Steamboat*, the world's first commercially successful steamboat, makes her maiden voyage.

• 1807 – Nicéphore Niépce installed his Pyréolophore internal combustion engine in a boat and powered up the river Saone in France.

• 1807 – Isaac de Rivas made a hydrogen gas powered internal combustion engine and mounted it on a vehicle.

• 1812 – First commercially successful self-propelled engine on land was Mathew Murray's *Salamanca* on Middleton Railway using toothed wheels and rail.

• 1812 – Timothy Hackworth's "Puffing Billy" ran on smooth Cast Iron Rails at Wylam Colliery near Newcastle
- 1814 – George Stephenson built the first practical steam-powered railway locomotive "Blutcher" at Killingworth Colliery.

- 1816 – The most likely originator of the Bicycle is the German, Baron Karl von Drais, who rode his 1816 machine while collecting taxes from his tenants.

- 1819 – SS Savannah, the first vessel to cross the Atlantic Ocean partly under steam power, arrives at Liverpool, England from Savannah, Georgia.

- 1822 – Stevenson built a locomotive and designed the railway for Hetton Colliery which is first railway not to use any horse-traction but it did have several rope hauled sections.

- 1822 – First Meeting of Liverpool Manchester Railway Company Permanent Committee.

- 1825 - Stevenson's Locomotion No. 1 runs on Stockton & Darlington Railway which opens as first public railway and uses horses and self-propelled steam engines and stationary engines with ropes along a single track. No stations and no timetables as anyone could hire the track to use their own vehicle on it.

- 1825 – Sir Goldsworthy Gurney invented a series of steam-powered passenger carriages and by 1829 completed the 120-mile journey from London to Bath, Somerset and back.

- 1826 – Bill passed for Liverpool and Manchester Railway at second attempt and George Stevenson commences work on 35-mile twin track line permitting simultaneous travel in both directions between the 2 towns. Means of traction not specified to reduce opposition.


- 1829 – Rainhill Trials to find best self-propelled engine for Liverpool Manchester line are won by Robert Stephenson's Rocket proving there is no need for horse traction or static engines on the main line. Rocket becomes basic formula for all future steam engines with boiler tubes, blast pipe, and the use of coal rather than coke.

- 1830 – Liverpool and Manchester Railway opens. First public transport system without animal traction, first public line with no rope hauled sections for main journey, first twin track, first railway between 2 large towns, first timetabled trains, first railway stations, first train faster than a mail coach, first tunnels under streets, first proper modern railway which formed the template for all subsequent railways.

- 1838 – Isambard Kingdom Brunel's SS Great Western, the first purpose-built transatlantic steamship, inaugurates the first regular transatlantic steamship service.

- 1839 - An early electric boat was developed by the German inventor Moritz von Jacobi in 1839 in St Petersburg, Russia. It was a 24-foot (7.3 m) boat which carried 14 passengers at 3 miles per hour (4.8 km/h). It was successfully demonstrated to Emperor Nicholas I of Russia on the Neva River.

- 1840s – Railway Mania sweeps UK and Ireland. 6,220 miles (10,010 km) of railway line were built
• 1843 - Dalkey Atmospheric railway opens.

Late 19th century

• 1852 – Elisha Otis invents the safety elevator.
• 1853 – Sir George Cayley built and demonstrated the first heavier-than-air aircraft (a glider).
• 1862 – Étienne Lenoir made a gasoline engine automobile.
• 1863 – London's Metropolitan Railway opened to the public as the world's first underground railway.
• 1867 – First modern motorcycle was invented.
• 1868 – Safety bicycle invented.
• 1868 – George Westinghouse invented the compressed-air brake for railway trains.
• 1868 – Louis-Guillaume Perreaux's steam velocipede, a steam engine attached to a Michaux velocipede.
• 1874 - Midland railway introduces the first bogie.
• 1880 - World's first electric tram line operated in Sestroretsk near Saint Petersburg, Russia, invented and tested by Fyodor Pirotsky.
• 1880 – Werner von Siemens builds first electric elevator.
• 1881 - World's first commercially successful electric tram, the Gross-Lichterfelde tramway in Lichterfelde near Berlin in Germany built by Werner von Siemens who contacted Pirotsky. It initially drew current from the rails, with overhead wire being installed in 1883.
• 1882 - The trolleybus dates back to 29 April 1882, when Dr. Ernst Werner Siemens demonstrated his "Elektromote" in a Berlin suburb. This experiment continued until 13 June 1882
• 1884 - Thomas Parker built a practical production electric car in Wolverhampton using his own specially designed high-capacity rechargeable batteries.
• 1885 – Karl Benz invents the first car powered by an internal combustion engine, he called it the Benz Patent Motorwagen.
• 1889 - The first interurban tram-train to emerge in the United States was the Newark and Granville Street Railway in Ohio, which opened in 1889.
• 1889 - First introduced in 1889, battery vehicles milk floats expanded use in 1931 and by 1967 gave Britain the largest electric vehicle fleet in the world.
• 1890s – Bike boom sweeps Europe and America with hundreds of bicycle manufacturers in the biggest bicycle craze to date
• 1890 - The City and South London Railway (C&SLR) was the first deep-level underground "tube" railway in the world, and the first major railway to use electric traction
1893 - first moving walkway debuted at the World's Columbian Exposition.
1893 - The Liverpool Overhead Railway opened on 6 March 1893 with 2-car electric multiple units, the first to operate in the world.
1894 – Hildebrand & Wolfmüller became the first motorcycle available to the public for purchase.
1896 – Jesse W. Reno builds first escalator at Coney Island, and then reinstall it on the Manhattan side of the Brooklyn Bridge.
1897 – Charles Parsons' Turbinia, the first vessel to be powered by a steam turbine, makes her debut.
1897 – Most likely the first electric bicycle was built in 1897 by Hosea W. Libbey.
1899 – Ferdinand von Zeppelin builds the first successful airship.

20th century

Early 20th century

1900 – Ferdinand von Zeppelin launches the first successful airship.
1903
  o Orville Wright and Wilbur Wright – Fly the first motor-driven airplane.
  o Diesel engine – Tested in a canal boat by Rudolph Diesel, Adrian Bochet and Frederic Dyckhoff.
  o first diesel motorship was also the first diesel–electric ship, the Russian tanker Vandal from Branobel, which was launched in 1903
1904 - The first non-experimental trolleybus system was a seasonal municipal line installed near Nantasket Beach in 1904; the first year-round commercial line was built to open a hilly property to development just outside Los Angeles in 1910.
1907 - The London Electrobus Company started running a service of battery-electric buses between London's Victoria Station and Liverpool Street on 15 July 1907.
1908 – Henry Ford develops the assembly line method of automobile manufacturing with the introduction of the Ford Model T.
1910 - Fabre Hydravion first seaplane.
1911 – Selandia launched – First ocean-going, diesel engine-driven ship.
1912 - The world's first diesel locomotive (a diesel-mechanical locomotive) was operated in the summer of 1912 on the Winterthur–Romanshorn railway in Switzerland.
1912 - Articulated trams, invented and first used by the Boston Elevated Railway.
The Luftkissingleitboot Hovercraft – First hovering vehicle was created by Dagobert Müller. It could only travel on water.

Motorized scooter invented.

A British commission was tasked with creating a vehicle able to cross a 4 ft wide trench – the tank.

- 1916 – First tank prototype, nicknamed "mother", was created by Britain during World War 1.
- 1924 - The world's first functional diesel locomotive (diesel-electric locomotive) (E42 original number 1001/Yu-e 001) started operations, designed by a team led by Yuri Lomonosov and built 1923–1924 by Maschinenfabrik Esslingen in Germany.
- 1926 – Robert Goddard launches the first liquid-fueled rocket.
- 1932 - The first electric golf cart was custom-made in 1932, but did not gain widespread acceptance.
- 1935 – First flight of the DC-3, one of the most significant transport aircraft in the history of aviation.
- 1939 – First jet engine powered aircraft, the Heinkel He 178, takes flight.
- 1942 – V2 rocket covers a distance of 200 kilometres (120 mi).
- 1947 – Chuck Yeager in the Bell X1 completes the first supersonic manned flight.

Late 20th Century

- 1955 – First nuclear-powered vessel, USS Nautilus, a submarine, is launched.
- 1957
  - Sputnik 1 – First artificial satellite to be launched into orbit.
  - Gateway City – World's first purpose-built container ship, enters service.
  - First flight of the Boeing 707 – First commercially successful jet airliner.
- 1959 - The first modern fuel cell vehicle was a modified Allis-Chalmers farm tractor, fitted with a 15 kilowatt fuel cell, around 1959.
- 1961 – Vostok 1, first crewed space mission, designed by Sergey Korolyov and Kerim Kerimov, makes two orbits around the Earth with Yuri Gagarin.
- 1966 - Caspian Sea Monster ground effect vehicle introduced.
- 1968 - Space hopper invented.
- 1969
  - First flight of the Boeing 747 – First commercial widebody airliner.
  - NASA rocket technology, spurred on by the US/Russia Space Race – Makes the first crewed Moon landing a reality.
- Lolo ball invented.
- 1971 – Salyut 1, first space station, launched by Soviet Union.
- 1975 – Morgantown PRT, first Personal Rapid Transit system to be installed.
- 1976 – Concorde makes the world's first commercial passenger-carrying supersonic flight.
- 1977 - The first semi-automated car was developed in 1977, by Japan's Tsukuba Mechanical Engineering Laboratory, which required specially marked streets.
- 1981 – Maiden flight of the Space Shuttle.
- 1989 - Snakeboard invented.
- 1990 - ADtranz low floor tram world's first completely low-floor tram introduced.
- 1994 – Channel Tunnel opens.
- 1997 – First Maglev train prototypes are tested in Japan.

21st century

- 2002 – Segway PT self-balancing personal transport was launched by inventor Dean Kamen.
- 2003 - Concorde makes last passenger flight.
- 2004 – First commercial high speed Maglev train starts operation between Shanghai and its airport.
- 2005 - Roller Buggy invented
- 2009 - Škoda 15 T world's first completely low-floor tram with articulated bogies introduced.
- 2010 – Ultra PRT, the first modern commercial Personal Rapid Transit system to be installed. Started operations at Heathrow Airport.
- 2013 - Self-balancing scooter invented.
- 2018 - Alstom Coradia iLint hydrogen-powered train entered service in Lower Saxony, Germany.

Maritime timeline

Prehistory

- About 45,000 BC: first humans arrive in Australia, presumably by boats and land bridge.
Antiquity

- About 6,000 BC: Earliest evidence of dugout canoes.
- 5th millennium BC: Earliest known depiction of a sailing boat.
- About 2,000 BC:
  - Hannu dispatches a fleet to the Land of Punt.
  - Austronesian people migrate from Taiwan to Indonesia, preceding the colonization of Polynesia.
- 1575–1520 BC Dover Bronze Age Boat, oldest known plank vessel, was built.
- About 1175 BC: Battle of the Delta, one of the first recorded naval battles, during Ancient Egypt's war against the Sea Peoples.
- 1194–1174 BC: Supposed timespan for the events of Homer's *Iliad* and *Odyssey*.
- About 1000 BC: Nusantaran people developed tanja sail and junk sail.
- Around 600 BC: According to Herodotus, Necho II sends Phoenician expedition to circumnavigate Africa.
- 6th century BC: Canal of the Pharaohs is built in Egypt.
- 542 BC: First written record of a trireme.
- 5th century BC: Hannu the Navigator explores the coast of West Africa.
- 480 BC: Battle of Salamis, arguably the largest naval battle in ancient times.
- 247 BC: Lighthouse of Alexandria completed.
- 214 BC: Lingqu Canal built.
- 31 BC: Battle of Actium decides the Final War of the Roman Republic.
- 100 AD: Large ships called K'un-lun Po sailed between China and India.
- About 200 AD: Chuan (junk ships) are developed in China. Chinese people learned junk rig from Malay people visiting their southern coast.

Middle Ages

- 793: The raid of Lindisfarne, first recorded Viking raid
- 916: Javanese invaded Khmer, using 1000 "medium-sized" vessels, which results in Javanese victory. The head of Khmer's king then brought to Java.
- 945: Malay people from Srivijaya attacked coast of Tanganyika and Mozambique with 1000 boats and attempted to take the citadel of Qanbaloh.
- 984: Pound locks used in China; See Technology of the Song Dynasty
- 986: Bjarni Herjolfsson crossed the Labrador Sea and saw North America.
- About 1000: Leif Ericson crossed the Labrador Sea to reach North America.
- 1025: Chola invasion of Srivijaya
- 1088: *Dream Pool Essays* by Shen Kuo, first description of a magnetic compass.
- 1159: Lübeck is rebuilt, and the Hanseatic League is founded.
- About 1190: Alexander Neckam writes the first European description of a magnetic compass.
- 13th century: Portolan charts are introduced in the Mediterranean.
- About 1280: Polynesian settlers arrive at New Zealand, the last major landmass to be populated.
- 1274: First Mongol invasion of Japan.
- 1325–1354: Ibn Batuta visits much of Africa and Asia
- 1350: Majapahit invades Samudera Pasai, with 400 jong.
- 1398: Majapahit invades Kingdom of Singapura, with 300 jong and no less than 200,000 men.
- 1405: Zheng He's expeditions begins.

**Age of Discovery**

- 1488: Bartolomeu Dias reaches the Cape of Good Hope.
- 1492: Christopher Columbus' first voyage, first recorded non-Arctic crossing of the Atlantic
- 1497: John Cabot reaches North American mainland, as first European since the Vikings.
- 1498
  - Vasco da Gama completes the Cape Route from Europe to India.
  - Columbus reaches continental South America.
- 1513: Jorge Álvares completes the first voyage from Europe to China.
- 1522: Ferdinand Magellan's last ship arrives in Europe, first recorded circumnavigation, and crossing of the Pacific Ocean
- 1571: Battle of Lepanto, last major naval battle fought entirely between galleys.
- 1580: Francis Drake returns home from Nehalem Bay, Oregon to become the 1st circumnavigation by an Englishman.
- 1588: The Spanish Armada is destroyed, shifting naval superiority to England.
- 1602: The Dutch East India Company is founded.
- 1606: Willem Janszoon becomes the first European to reach Australia.
- 1620: Cornelis Drebbel constructs the first submarine.
- 1628: The *Vasa* sinks in Stockholm harbour on its maiden voyage.
- 1736: John Harrison tests the first successful marine chronometer.
- 1757: First sextant constructed
- 1771: James Cook completes the first circumnavigation without casualties to scurvy.
- 1790: Battle of Svensksund, the last major battle with participation of galleys.

**Rise of steamboats and motorships**

- 1783: Claude de Jouffroy constructs the first recorded steamboat.
- 1790: Canal Mania begins in Great Britain.
- 1805: The battle of Trafalgar marks the rise of the Royal Navy to a century of world domination.
- 1807: *North River Steamboat*, the first commercially successful steamboat, is launched.
- 1819: SS *Savannah* under Capt. Moses Rogers makes first transatlantic crossing using (auxiliary) steam power.
- 1820: Fabian Gottlieb von Bellingshausen discovers mainland Antarctica; the only recorded discovery of an uninhabited continent.
- 1839: An early electric boat was developed by the German inventor Moritz von Jacobi in 1839 in St Petersburg, Russia. It was a 24-foot (7.3 m) boat which carried 14 passengers at 3 miles per hour (4.8 km/h). It was successfully demonstrated to Emperor Nicholas I of Russia on the Neva River.
- 1845: SS *Great Britain* becomes first iron steamer to cross the Atlantic.
- 1856: Paris Declaration Respecting Maritime Law outlaws privateering.
- 1859: The first ironclad warship, the *Gloire*, is launched.
- 1861: USS *Ice Boat* (1861), the first purpose-built icebreaker, is launched.
- 1862: The Battle of Hampton Roads becomes the first battle between ironclads.
- 1864: *Ictineo II*, the first submarine powered by an internal-combustion engine.
- 1869: The Suez Canal opens.
- 1871: Adolf Erik Nordenskiöld braves the Northeast Passage on the *Vega*
- 1880: The American passenger steamship *Columbia* becomes the first outside usage of Thomas Edison's incandescent light bulb.
- 1893: The Corinth Canal opens.
- 1894: The *Turbinia*, the world's first turbine-powered ship, is launched.
• 1895: The Kiel Canal opens.
• 1903: The Vandal, the world's first diesel-electric ship, is launched.
• 1906
  o Roald Amundsen conquers the Northwest Passage on the Gjøa.
  o HMS Dreadnought launched, commencing the era of battleships.
• 1914: The Panama Canal opens.
• 1916: Battle of Jutland, claimed to be the largest naval battle in history, counting tonnage of engaged ships.
• 1918: HMS Furious (47) becomes the first aircraft carrier used in warfare.
• 1937: USS Leary (DD-158) becomes the first American vessel to be equipped with radar.
• 1941: The attack on Pearl Harbor starts the Pacific War.
• 1942: The battle of Midway marks the demise of battleships and the domination of aircraft carriers.
• 1944: Normandy landings, the largest amphibious invasion in history.
• 1951: The first purpose-built container ships enter operation.
• 1955: USS Nautilus (SSN-571), the world's first nuclear-powered vessel, is launched.
• 1957: Aircraft supplants shipping as the leading mode of passenger Transatlantic travel.
• 1959:
  o The USS Skate (SSN-578) surfaces at the North Pole.
  o The SR.N1, the first practical hovercraft, is launched.
• 1960: The Trieste descends to the Challenger Deep.
• 1962: The Cuban Missile Crisis; a major naval confrontation between the United States and the Soviet Union.
• 1977: Russian icebreaker Arktika makes the first surface voyage to the North Pole.
• 1982: Falklands War, one of the largest naval campaigns since World War II.
• 1985: The Sea Shadow (IX-529), an early stealth ship, is launched.
• 1987: The MV Doña Paz is lost, claiming 4,375 lives, the worst peacetime maritime disaster in history.
• 1994:
  o The Global Positioning System becomes operational.
  o M/S Estonia is lost in the Baltic Sea.
• 2005: Piracy in Somalia becomes an international concern.
• 2007: Arktika 2007 becomes the first manned expedition to the North Pole seabed.
• 2012:
  o M/S Costa Concordia disaster.
  o James Cameron reaches the Challenger Deep solo with the Deepsea Challenger.

• 2013: MS Nordic Orion becomes the first freighter to complete the Northwest Passage.

Timeline of hypertext technology

1940s

• 1941
  o Jorge Luis Borges' "The Garden of Forking Paths"

• 1945
  o Memex (concept by Vannevar Bush)

1960s

• 1960
  o Project Xanadu (concept)

• 1962
  o Marshall McLuhan's *The Gutenberg Galaxy* uses the term *surfing*

• 1967
  o Hypertext Editing System (HES) by Andries van Dam and Ted Nelson at Brown University

• 1968
  o FRESS (File Retrieval and Editing System, successor to HES)
  o NLS (oN-Line System)

1970s

• 1972
  o ZOG

• 1973
  o Xerox Alto desktop

• 1976
- PROMIS

- 1978
  - Aspen Movie Map

- 1979
  - PERQ

1980s

- 1980
  - ENQUIRE (not released)

- 1981
  - Electronic Document System (EDS, aka Document Presentation System)
  - Kussmaul Encyclopedia
  - Xerox Star desktop

- 1982
  - Guide

- 1983
  - Knowledge Management System (KMS, successor to ZOG)
  - TIES (The Interactive Encyclopedia System, later HyperTies)

- 1984
  - NoteCards

- 1985
  - Intermedia (successor to FRESS and EDS)
  - Symbolics Document Examiner (Symbolics workstations)

- 1986
  - TextNet (a network-based approach to text handling)
  - Neptune (a hypertext system for CAD applications)

- 1987
  - Macromedia Authorware
  - Canon Cat ("Leap" function, interface)
  - HyperCard
  - Knowledge Navigator (concept described by former Apple Computer CEO John Sculley in his book *Odyssey*)

- 1988
- Microcosm (hypermedia system) (University of Southampton)

1989
- Macromedia Director
- Information Management: a proposal, Tim Berners-Lee, CERN

1990s

- 1990
  - DynaText
  - World Wide Web
  - Hyperland (BBC documentary written by Douglas Adams)
  - ToolBook
- 1991
  - Gopher
  - AmigaGuide
- 1995
  - Wiki
- 1996
  - Hyperwire (Kinetix)
- 1998
  - Everything2
  - XML
- 1999
  - RSS

2000s

- 2001
  - Wikipedia
- 2014
  - OpenXanadu, an implementation of Project Xanadu
Timeline of medicine and medical technology

Antiquity

- 3300 BC – During the Stone Age, early doctors used very primitive forms of herbal medicine.
- 3000 BC – Ayurveda The origins of Ayurveda have been traced back to around 4,000 BCE.
- c. 2600 BC – Imhotep the priest-physician who was later deified as the Egyptian god of medicine.
- 2500 BC – Iry Egyptian inscription speaks of Iry as [eye-doctor of the palace,] [palace physician of the belly,] [guardian of the royal bowels,] and [he who prepares the important medicine (name cannot be translated) and knows the inner juices of the body.]
- 1900 BC – 1600 BC Akkadian clay tablets on medicine survive primarily as copies from Ashurbanipal’s library at Nineveh.
- 1800 BC – Code of Hammurabi sets out fees for surgeons and punishments for malpractice
- 1800 BC – Kahun Gynecological Papyrus
- 1600 BC – Hearst papyrus, coprotherapy and magic
- 1551 BC – Ebers Papyrus, coprotherapy and magic
- 1500 BC – Saffron used as a medicine on the Aegean island of Thera in ancient Greece
- 1500 BC – Edwin Smith Papyrus, an Egyptian medical text and the oldest known surgical treatise (no true surgery) no magic
- 1300 BC – Brugsch Papyrus and London Medical Papyrus
- 1250 BC – Asklepios
- 9th century – Hesiod reports an ontological conception of disease via the Pandora myth. Disease has a "life" of its own but is of divine origin.
- 8th century – Homer tells that Polydamna supplied the Greek forces besieging Troy with healing drugs Homer also tells about battlefield surgery Idomeneus tells Nestor after Machaon had fallen: *A surgeon who can cut out an arrow and heal the wound with his ointments is worth a regiment.*
- 700 BC – Cnidos medical school; also one at Cos
- 500 BC – Darius I orders the restoration of the *House of Life* (First record of a (much older) medical school)
- 500 BC – Bian Que becomes the earliest physician known to use acupuncture and pulse diagnosis
- 500 BC – the Sushruta Samhita is published, laying the framework for Ayurvedic medicine
- c. 490 – c. 430 – Empedocles four elements
- 500 BC - Pills were used. They were presumably invented so that measured amounts of a medicinal substance could be delivered to a patient.

- 510–430 BC – Alcmaeon of Croton scientific anatomic dissections. He studied the optic nerves and the brain, arguing that the brain was the seat of the senses and intelligence. He distinguished veins from the arteries and had at least vague understanding of the circulation of the blood. Various modern scholars have described him as Father of Anatomy; Father of Physiology; Father of Embryology; Father of Psychology; Creator of Psychiatry; Founder of Gynecology; and as the Father of Medicine itself. There is little evidence to support the claims but he is, nonetheless, important.

- fl. 425 BC – Diogenes of Apollonia

- c. 484 – 425 BC – Herodotus tells us Egyptian doctors were specialists: *Medicine is practiced among them on a plan of separation; each physician treats a single disorder, and no more. Thus the country swarms with medical practitioners, some undertaking to cure diseases of the eye, others of the head, others again of the teeth, others of the intestines, and some those which are not local.*

- 496–405 BC – Sophocles "It is not a learned physician who sings incantations over pains which should be cured by cutting."

- 420 BC – Hippocrates of Cos maintains that diseases have natural causes and puts forth the Hippocratic Oath. Origin of rational medicine.

### Medicine after Hippocrates

- c. 400 BC – 1 BC – The *Huangdi Neijing (Yellow Emperor's Classic of Internal Medicine)* is published, laying the framework for traditional Chinese medicine

- 4th century BC – Philistion of Locri Praxagoras distinguishes veins and arteries and determines only arteries pulse

- 375–295 BC – Diocles of Carystus

- 354 BC – Critobulus of Cos extracts an arrow from the eye of Phillip II, treating the loss of the eyeball without causing facial disfigurement.

- 3rd century BC – Philinus of Cos founder of the Empiricist school. Herophilus and Erasistratus practice androtomy. (Dissecting live and dead human beings)

- 280 BC – Herophilus Dissection studies the nervous system and distinguishes between sensory nerves and motor nerves and the brain. also the anatomy of the eye and medical terminology such as (in Latin translation "net like" becomes *retiform*/retina.

- 270 – Huangfu Mi writes the *Zhenjiu Jiayijing (The ABC Compendium of Acupuncture)*, the first textbook focusing solely on acupuncture.
• 250 BC – Erasistratus studies the brain and distinguishes between the cerebrum and cerebellum physiology of the brain, heart and eyes, and in the vascular, nervous, respiratory and reproductive systems.
• 219 – Zhang Zhongjing publishes Shang Han Lun (On Cold Disease Damage).
• 200 BC – the Charaka Samhita uses a rational approach to the causes and cure of disease and uses objective methods of clinical examination
• 124–44 BC – Asclepiades of Bithynia
• 116–27 BC – Marcus Terentius Varro Germ theory of disease No one paid any attention to it.
• 1st century AD – Rufus of Ephesus; Marcellinus a physician of the first century AD; Numisianus
• 23 AD – 79 AD – Pliny the Elder writes Natural History
• c. 25 BC – c. 50 AD – Aulus Cornelius Celsus Medical encyclopedia
• 50–70 AD – Pedanius Dioscorides writes De Materia Medica – a precursor of modern pharmacopoeias that was in use for almost 1600 years
• 2nd century AD Aretaeus of Cappadocia
• 98–138 AD – Soranus of Ephesus
• 129–216 AD – Galen – Clinical medicine based on observation and experience. The resulting tightly integrated and comprehensive system, offering a complete medical philosophy dominated medicine throughout the Middle Ages and until the beginning of the modern era.

After Galen 200 AD

• d. 260 – Gargilius Martialis, short Latin handbook on Medicines from Vegetables and Fruits
• 4th century Magnus of Nisibis, Alexandrian doctor and professor book on urine
• 325–400 – Oribasius 70 volume encyclopedia
• 362 – Julian orders xenones built, imitating Christian charity (proto hospitals)
• 369 – Basil of Caesarea founded at Caesarea in Cappadocia an institution (hospital) called Basilias, with several buildings for patients, nurses, physicians, workshops, and schools
• 375 – Ephrem the Syrian opened a hospital at Edessa They spread out and specialized nosocomia for the sick, brephotrophia for foundlings, orphanotrophia for orphans, ptochia for the poor, xenodochia for poor or infirm pilgrims, and gerontochia for the old.
• 400 – The first hospital in Latin Christendom was founded by Fabiola at Rome
• 420 – Caelius Aurelianus a doctor from Sicca Veneria (El-Kef, Tunisia) handbook On Acute and Chronic Diseases in Latin.
- 447 – Cassius Felix of Cirta (Constantine, Ksantina, Algeria), medical handbook drew on Greek sources, Methodist and Galenist in Latin
- 480–547 Benedict of Nursia founder of "monastic medicine"
- 484–590 – Flavius Magnus Aurelius Cassiodorus
- fl. 511–534 – Anthimus Greek: Ἀντίμος
- 536 – Sergius of Reshaina (died 536) – A Christian theologian-physician who translated thirty-two of Galen's works into Syriac and wrote medical treatises of his own
- 525–605 – Alexander of Tralles Alexander Trallianus
- 500–550 – Aetius of Amida Encyclopedia 4 books each divided into 4 sections
- second half of 6th century building of xenodocheions/bimærêstâns by the Nestorians under the Sasanians, would evolve into the complex secular "Islamic hospital", which combined lay practice and Galenic teaching
- 550–630 Stephanus of Athens
- 560–636 – Isidore of Seville
- c. 620 Aaron of Alexandria Syriac. He wrote 30 books on medicine, the "Pandects". He was the first author in antiquity who mentioned the diseases of smallpox and measles translated by Māsarjawalīh a Syrian Jew and Physician, into Arabic about A. D. 683
- c. 630 – Paul of Aegina Encyclopedia in 7 books very detailed surgery used by Albucasis
- 790–869 – Leo Itrosophist also Mathematician or Philosopher wrote "Epitome of Medicine"
- c. 800–873 – Al-Kindi (Alkindus) De Gradibus
- 820 – Benedictine hospital founded, School of Salerno would grow around it
- 857d – Mesue the elder (Yūḥannā ibn Māsawayh) Syriac Christian
- c. 830–870 – Hunayn ibn Ishaq (Johannitius) Syriac-speaking Christian also knew Greek and Arabic. Translator and author of several medical tracts.
- c. 910d – Ishaq ibn Hunayn
- 9th century – Yahya ibn Sarafyun a Syriac physician Johannes Serapion, Serapion the Elder
- c. 865–925 – Rhazes pediatrics, and makes the first clear distinction between smallpox and measles in his al-Hawi.
- d. 955 – Isaac Judaeus Ishāq ibn Sulaymān al-Isrā’īlī Egyptian born Jewish physician
- 913–982 – Shabbethai Donnolo alleged founding father of School of Salerno wrote in Hebrew
- d. 982–994 – 'Ali ibn al-'Abbas al-Majusi Haly Abbas
1000 – Albucasis (936–1018) surgery *Kitab al-Tasrif*, surgical instruments.

1075 – Ibn Butlan Christian physician of Baghdad Tacuinum sanitatis the Arabic original and most of the Latin copies, are in tabular format

1018–1087 – Michael Psellus or Psellus a Byzantine monk, writer, philosopher, politician and historian. several books on medicine

1030 – Avicenna *The Canon of Medicine* The *Canon* remains a standard textbook in Muslim and European universities until the 18th century.

1071–1078 – Simeon Seth or Symeon Seth an 11th-century Jewish Byzantine translated Arabic works into Greek

1084 – First documented hospital in England Canterbury

1087d – Constantine the African

1083–1153 – Anna Komnene, Latinized as Comnena

1095 – Congregation of the Antonines, was founded to treat victims of "St. Anthony's fire" a skin disease.

late 11th early 12th century – Trotula

1123 – St Bartholomew's Hospital founded by the court jester Rahere Augustine nuns originally cared for the patients. Mental patients were accepted along with others

1127 – Stephen of Antioch translated the work of Haly Abbas

1100–1161 – Avenzoar Teacher of Averroes

1170 – Rogerius Salernitanus composed his *Chirurgia* also known as *The Surgery of Roger*

1126–1198 – Averroes

1161 – Matthaeus Platearius

1126 – Constantine the African

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1161 – Matthaeus Platearius

1203 – Innocent III organized the hospital of Santo Spirito at Rome inspiring others all over Europe

1210–1277 – William of Saliceto, also known as Gulielmus de Saliceto

1210–1295 – Taddeo Alderotti – Scholastic medicine

1240 Bartholomeus Anglicus

1242 – Ibn an-Nafis suggests that the right and left ventricles of the heart are separate and discovers the pulmonary circulation and coronary circulation

1248 – Ibn al-Baitar wrote on botany and pharmacy, studied animal anatomy and medicine veterinary medicine.

1249 – Roger Bacon writes about convex lens spectacles for treating long-sightedness
• 1257 – 1316 Pietro d'Abano also known as Petrus De Apono or Aponensis
• 1260 – Louis IX established Les Quinze-vingt; originally a retreat for the blind, it became a hospital for eye diseases, and is now one of the most important medical centers in Paris
• c. 1260–1320 Henri de Mondeville
• 1284 – Mansur hospital of Cairo
• c. 1275 – c. 1328 Joannes Zacharias Actuarius a Byzantine physician wrote the last great compendium of Byzantine medicine
• 1275–1326 – Mondino de Luzzi "Mundinus" carried out the first systematic human dissections since Herophilus of Chalcedon and Erasistratus of Ceos 1500 years earlier.
• 1288 – The hospital of Santa Maria Nuova founded in Florence, it was strictly medical.
• 1300 – concave lens spectacles to treat myopia developed in Italy.
• 1310 – Pietro d'Abano's Conciliator (c. 1310)
• d. 1348 – Gentile da Foligno
• 1292–1350 – Ibn Qayyim al-Jawziya
• 1306–1390 – John of Arderne
• d. 1368 – Guy de Chauliac
• f. 1460 – Heinrich von Pfolspeundt
• 1443–1502 – Antonio Benivieni Pathological anatomy
• 1493–1541 – Paracelsus On the relationship between medicine and surgery

1500–1799

• early 16th century:
  o Paracelsus, an alchemist by trade, rejects occultism and pioneers the use of chemicals and minerals in medicine. Burns the books of Avicenna, Galen and Hippocrates.
  o Hieronymus Fabricius His "Surgery" is mostly that of Celsus, Paul of Aegina, and Abulcasis citing them by name.
  o Caspar Stromayr or Stromayer Sixteenth Century
• 1500?–1561 Pierre Franco
• Ambroise Paré (1510–1590) pioneered the treatment of gunshot wounds.
  o Bartholomeo Maggi at Bologna, Felix Wurtz of Zurich, Léonard Botal in Paris, and the Englishman Thomas Gale (surgeon), (the diversity of their geographical origins attests to the
widespread interest of surgeons in the problem), all published works urging similar treatment to Paré's. But it was Paré's writings which were the most influential.

- 1518 – College of Physicians founded now known as Royal College of Physicians of London is a British professional body of doctors of general medicine and its subspecialties. It received the royal charter in 1518
- 1510–1590 – Ambroise Paré surgeon
- 1540–1604 – William Clowes – Surgical chest for military surgeons
- 1543 – Andreas Vesalius publishes De Fabrica Corporis Humani which corrects Greek medical errors and revolutionizes European medicine
- 1546 – Girolamo Fracastoro proposes that epidemic diseases are caused by transferable seedlike entities
- 1550–1612 – Peter Lowe
- 1553 – Miguel Serveto describes the circulation of blood through the lungs. He is accused of heresy and burned at the stake
- 1556 – Amato Lusitano describes venous valves in the Ázigos vein
- 1559 – Realdo Colombo describes the circulation of blood through the lungs in detail
- 1563 – Garcia de Orta founds tropical medicine with his treatise on Indian diseases and treatments
- 1570–1643 – John Woodall Ship surgeons used lemon juice to treat scurvy wrote "The Surgions Mate"
- 1590 – Microscope was invented, which played a huge part in medical advancement
- 1596 – Li Shizhen publishes Běncǎo Gāngmù or Compendium of Materia Medica
- 1603 – Girolamo Fabrici studies leg veins and notices that they have valves which allow blood to flow only toward the heart
- 1621–1676 – Richard Wiseman
- 1628 – William Harvey explains the circulatory system in Exercitatio Anatomica de Motu Cordis et Sanguinis in Animalibus
- 1638–1758 – Lorenz Heister
- 1688–1752 – William Cheselden
- 1701 – Giacomo Pylarini gives the first smallpox inoculations in Europe. They were widely practised in the East before then.
- 1714–1789 – Percivall Pott
- 1720 – Lady Mary Wortley Montagu
- 1728–1793 – John Hunter
- 1736 – Claudius Aymand performs the first successful appendectomy
- 1744–1795 – Pierre-Joseph Desault First surgical periodical
• 1747 – James Lind discovers that citrus fruits prevent scurvy
• 1749–1806 – Benjamin Bell – Leading surgeon of his time and father of a surgical dynasty system of surgery
• 1752–1832 – Antonio Scarpa
• 1763–1820 – John Bell
• 1766–1842 – Dominique Jean Larrey Surgeon to Napoleon
• 1768–1843 – Astley Cooper surgeon lectures principles and practice
• 1774–1842 – Charles Bell, surgeon
• 1774 – Joseph Priestley discovers nitrous oxide, nitric oxide, ammonia, hydrogen chloride and oxygen
• 1777–1835 – Baron Guillaume Dupuytren – Head surgeon at Hôtel-Dieu de Paris, The age Dupuytren
• 1785 – William Withering publishes "An Account of the Foxglove" the first systematic description of digitalis in treating dropsy
• 1790 – Samuel Hahnemann rages against the prevalent practice of bloodletting as a universal cure and founds homeopathy
• 1796 – Edward Jenner develops a smallpox vaccination method
• 1799 – Humphry Davy discovers the anesthetic properties of nitrous oxide

1800–1899

• 1800 – Humphry Davy announces the anaesthetic properties of nitrous oxide.
• 1803–1805 – Morphine was first isolated by Friedrich Sertürner, this is generally believed to be the first isolation of an active ingredient from a plant.
• 1813–1883 – James Marion Sims vesico-vaginal surgery Father of surgical gynecology.
• 1816 – Rene Laennec invents the stethoscope.
• 1827–1912 – Joseph Lister antisepic surgery Father of modern surgery
• 1818 – James Blundell performs the first successful human transfusion.
• 1842 – Crawford Long performs the first surgical operation using anesthesia with ether.
• 1845 – John Hughes Bennett first describes leukemia as a blood disorder.
• 1846 – First painless surgery with general anesthetic.
• 1847 – Ignaz Semmelweis discovers how to prevent puerperal fever.
• 1849 – Elizabeth Blackwell is the first woman to gain a medical degree in the United States.
1850 – Female Medical College of Pennsylvania (later Woman’s Medical College), the first medical college in the world to grant degrees to women, is founded in Philadelphia.

1858 – Rudolf Carl Virchow 13 October 1821 – 5 September 1902 his theories of cellular pathology spelled the end of Humoral medicine.

1867 – Lister publishes *Antiseptic Principle of the Practice of Surgery*, based partly on Pasteur's work.

1870 – Louis Pasteur and Robert Koch establish the germ theory of disease.

1878 – Ellis Reynolds Shipp graduates from the Women’s Medical College of Pennsylvania and begins practice in Utah.

1879 – First vaccine for cholera.

1881 – Louis Pasteur develops an anthrax vaccine.

1882 – Louis Pasteur develops a rabies vaccine.

1890 – Emil von Behring discovers antitoxins and uses them to develop tetanus and diphtheria vaccines.

1895 – Wilhelm Conrad Röntgen discovers medical use of X-rays in medical imaging.

1900–1999

1901 – Karl Landsteiner discovers the existence of different human blood types

1901 – Alois Alzheimer identifies the first case of what becomes known as Alzheimer's disease

1903 – Willem Einthoven invents electrocardiography (ECG/EKG)

1906 – Frederick Hopkins suggests the existence of vitamins and suggests that a lack of vitamins causes scurvy and rickets

1907 – Paul Ehrlich develops a chemotherapeutic cure for sleeping sickness

1907 – Henry Stanley Plummer develops the first structured patient record and clinical number (Mayo clinic)

1908 – Victor Horsley and R. Clarke invents the stereotactic method

1909 – First intrauterine device described by Richard Richter.

1910 – Hans Christian Jacobaeus performs the first laparoscopy on humans

1917 – Julius Wagner-Jauregg discovers the malarial fever shock therapy for general paresis of the insane

1921 – Edward Mellanby discovers vitamin D and shows that its absence causes rickets

1921 – Frederick Banting and Charles Best discover insulin – important for the treatment of diabetes

1921 – Fidel Pagés pioneers epidural anesthesia

1923 – First vaccine for diphtheria
1926 – First vaccine for pertussis
1927 – First vaccine for tuberculosis
1927 – First vaccine for tetanus
1928 – Alexander Fleming discovers penicillin
1929 – Hans Berger discovers human electroencephalography
1930 – first successful sex reassignment surgery performed on lili Elbe in Dresden, Germany.
1932 – Gerhard Domagk develops a chemotherapeutic cure for streptococcus
1933 – Manfred Sakel discovers insulin shock therapy
1935 – Ladislas J. Meduna discovers metrazol shock therapy
1935 – First vaccine for yellow fever
1936 – Egas Moniz discovers prefrontal lobotomy for treating mental diseases; Enrique Finochietto develops the now ubiquitous self-retaining thoracic retractor
1938 – Ugo Cerletti and Lucio Bini discover electroconvulsive therapy
1938 – Howard Florey and Ernst Chain investigate Penicillin and attempted to mass-produce it and tested it on the policeman Albert Alexander (police officer) who recovered but died due to a lack of Penicillin
1943 – Willem J. Kolff build the first dialysis machine
1944 – Disposable catheter – David S. Sheridan
1946 – Chemotherapy – Alfred G. Gilman and Louis S. Goodman
1947 – Defibrillator – Claude Beck
1948 – Acetaminophen – Julius Axelrod, Bernard Brodie
1949 – First implant of intraocular lens, by Sir Harold Ridley
1949 – Mechanical assistor for anesthesia – John Emerson
1952 – Jonas Salk develops the first polio vaccine (available in 1955)
1952 – Cloning – Robert Briggs and Thomas King
1953 – Heart-lung machine – John Heysham Gibbon
1953 – Medical ultrasonography – Inge Edler
1954 – Joseph Murray performs the first human kidney transplant (on identical twins)
1954 – Ventouse – Tage Malmstrom
1955 – Tetracycline – Lloyd Conover
1956 – Metered-dose inhaler – 3M
1957 – William Grey Walter invents the brain EEG topography (toposcope)
• 1958 – Pacemaker – Rune Elmqvist
• 1959 – In vitro fertilization – Min Chueh Chang
• 1960 – Invention of cardiopulmonary resuscitation (CPR)
• 1960 – First combined oral contraceptive approved by the FDA
• 1962 – Hip replacement – John Charnley
• 1962 – Beta blocker James W. Black
• 1962 – First oral polio vaccine (Sabin)
• 1963 – Artificial heart – Paul Winchell
• 1963 – Thomas Starzl performs the first human liver transplant
• 1963 – James Hardy performs the first human lung transplant
• 1963 – Valium (diazepam) – Leo H. Sternbach
• 1964 – First vaccine for measles
• 1965 – Frank Pantridge installs the first portable defibrillator
• 1965 – First commercial ultrasound
• 1966 – C. Walton Lillehei performs the first human pancreas transplant
• 1966 – Rubella Vaccine – Harry Martin Meyer and Paul D. Parkman
• 1967 – First vaccine for mumps
• 1967 – Christiaan Barnard performs the first human heart transplant
• 1968 – Powered prothesis – Samuel Alderson
• 1968 – Controlled drug delivery – Alejandro Zaffaroni
• 1969 – Balloon catheter – Thomas Fogarty
• 1969 – Cochlear implant – William House
• 1970 – Cyclosporine, the first effective immunosuppressive drug is introduced in organ transplant practice
• 1971 - MMR Vaccine - developed by Maurice Hilleman
• 1971 – Genetically modified organisms – Ananda Chakrabart
• 1971 – Magnetic resonance imaging – Raymond Vahan Damadian
• 1971 – Computed tomography (CT or CAT Scan) – Godfrey Hounsfield
• 1971 – Transdermal patches – Alejandro Zaffaroni
• 1971 – Sir Godfrey Hounsfield invents the first commercial CT scanner
• 1972 – Insulin pump Dean Kamen
• 1973 – Laser eye surgery (LASIK) – Mani Lal Bhaumik
• 1974 – Liposuction – Giorgio Fischer
• 1976 – First commercial PET scanner
• 1978 – Last fatal case of smallpox
• 1979 – Antiviral drugs – George Hitchings and Gertrude Elion
• 1980 – Raymond Damadian builds first commercial MRI scanner
• 1980 – Lithotripter – Dornier Research Group
• 1980 – First vaccine for hepatitis B – Baruch Samuel Blumberg
• 1981 – Artificial skin – John F. Burke and Ioannis V Yannas
• 1981 – Bruce Reitz performs the first human heart-lung combined transplant
• 1982 – Human insulin – Eli Lilly
• Interferon cloning – Sidney Pestka
• 1985 – Automated DNA sequencer – Leroy Hood and Lloyd Smith
• 1985 – Polymerase chain reaction (PCR) – Kary Mullis
• 1985 – Surgical robot – Yik San Kwoh
• 1985 – DNA fingerprinting – Alec Jeffreys
• 1985 – Capsule endoscopy – Tarun Mullick
• 1986 – Fluoxetine HCl – Eli Lilly and Co
• 1987 – Ben Carson, leading a 70-member medical team in Germany, was the first to separate occipital craniopagus twins.
• 1987 – commercially available Statins – Merck & Co.
• 1987 – Tissue engineering – Joseph Vacanti & Robert Langer
• 1988 – Intravascular stent – Julio Palmaz
• 1988 – Laser cataract surgery – Patricia Bath
• 1989 – Pre-implantation genetic diagnosis (PGD) – Alan Handyside
• 1989 – DNA microarray – Stephen Fodor
• 1990 – Gamow bag® – Igor Gamow
• 1992 – First vaccine for hepatitis A available
• 1992 – Electroactive polymers (artificial muscle) – SRI International
• 1992 – Intracytoplasmic sperm injection (ICSI) – Andre van Steirteghem
• 1996 – Dolly the Sheep cloned
• 1998 – Stem cell therapy – James Thomson

2000–present

• 2000 26 June – The Human Genome Project draft was completed.
• 2001 The first telesurgery was performed by Jacques Marescaux.
• 2003 – Carlo Urbani, of Doctors without Borders alerted the World Health Organization to the threat of the SARS virus, triggering the most effective response to an epidemic in history. Urbani succumbs to the disease himself in less than a month.
• 2005 – Jean-Michel Dubernard performs the first partial face transplant.
• 2006 – First HPV vaccine approved.
• 2006 – The second rotavirus vaccine approved (first was withdrawn).
• 2007 – The visual prosthetic (bionic eye) Argus II.
• 2008 – Laurent Lantieri performs the first full face transplant.
• 2011 - first successful Uterus transplant from a deceased donor in Turkey
• 2013 – The first kidney was grown in vitro in the U.S.
• 2013 – The first human liver was grown from stem cells in Japan.
• 2014 - A 3D printer is used for first ever skull transplant.
• 2016 - The first ever artificial pancreas was created
• 2019 – 3D-print heart from human patient's cells.

Timeline of science and engineering in the Islamic world

Eighth Century

Chemistry

• 721 – 815: Jabir ibn Hayyan (Latinized name, Geber,). First chemist known to produce sulfuric acid, as well as many other chemicals and instruments. Wrote on adding color to glass by adding small quantities of metallic oxides to the glass, such as manganese dioxide. This was a new advance in glass industry unknown in antiquity. His works include The Elaboration of the Grand Elixir; The Chest of Wisdom in which he writes on nitric acid; Kitab al-istitmam (translated to Latin later as Summa Perfectionis); and others.
Mathematics

- **780 – 850**: Al-Khwarizmi developed the "calculus of resolution and juxtaposition" (*hisab al-jabr w'al-muqabala*), more briefly referred to as al-jabr, or algebra.

**Ninth Century**

Chemistry

- **801 – 873**: Al-Kindi writes on the distillation of wine as that of rose water and gives 107 recipes for perfumes, in his book *Kitab Kimia al-`otoor wa al-tas`eedat* (book of the chemistry of perfumes and distillations.)
- **854 – 930**: Al-Razi wrote on Naft (naphta or petroleum) and its distillates in his book "Kitab sirr al-asrar" (book of the secret of secrets.) When choosing a site to build Baghdad's hospital, he hung pieces of fresh meat in different parts of the city. The location where the meat took the longest to rot was the one he chose for building the hospital. Advocated that patients not be told their real condition so that fear or despair do not affect the healing process. Wrote on alkali, caustic soda, soap and glycerine. Gave descriptions of equipment processes and methods in his book *Kitab al-Asrar* (book of secrets) in 925.

Mathematics

- **826 – 901**: Thabit ibn Qurra (Latinized, Thebit.) Studied at Baghdad's House of Wisdom under the Banu Musa brothers. Discovered a theorem which enables pairs of amicable numbers to be found. Later, al-Baghdadi (b. 980) developed a variant of the theorem.

**Miscellaneous**

- **c. 810**: Bayt al-Hikma (House of Wisdom) set up in Baghdad. There Greek and Indian mathematical and astronomy works are translated into Arabic.
- **810 – 887**: Abbas ibn Firnas. Planetarium, artificial crystals. According to one account written seven centuries after his death, Ibn Firmas was injured during an elevated winged trial flight.

**Tenth Century**

By this century, three systems of counting are used in the Arab world. Finger-reckoning arithmetic, with numerals written entirely in words, used by the business community; the sexagesimal system, a remnant originating with the Babylonians, with numerals denoted by letters of the arabic alphabet and used by Arab mathematicians in
astronomical work; and the Indian numeral system, which was used with various sets of symbols. Its arithmetic at first required the use of a dust board (a sort of handheld blackboard) because "the methods required moving the numbers around in the calculation and rubbing some out as the calculation proceeded."

Chemistry

- **957**: Abul Hasan Ali Al-Masudi, wrote on the reaction of alkali water with zaj (vitriol) water giving sulfuric acid.

Mathematics

- **920**: al-Uqlidisi. Modified arithmetic methods for the Indian numeral system to make it possible for pen and paper use. Hitherto, doing calculations with the Indian numerals necessitated the use of a dust board as noted earlier.
- **940**: Born Abu'l-Wafa al-Buzjani. Wrote several treatises using the finger-counting system of arithmetic, and was also an expert on the Indian numerals system. About the Indian system he wrote: "[it] did not find application in business circles and among the population of the Eastern Caliphate for a long time." Using the Indian numeral system, abu'l Wafa was able to extract roots.
- **980**: al-Baghdadi Studied a slight variant of Thabit ibn Qurra's theorem on amicable numbers. Al-Baghdadi also wrote about and compared the three systems of counting and arithmetic used in the region during this period.

Eleventh Century

Mathematics

- **1048 – 1131**: Omar Khayyam. Persian mathematician and poet. "Gave a complete classification of cubic equations with geometric solutions found by means of intersecting conic sections." Extracted roots using the decimal system (the Indian numeral system).

Twelfth Century

Cartography

- **1100–1165**: Muhammad al-Idrisi, aka Idris al-Saqalli aka al-sharif al-idrissi of Andalusia and Sicily. Known for having drawn some of the most advanced ancient world maps.
Mathematics

- **1130–1180**: Al-Samawal. An important member of al-Karaji's school of algebra. Gave this definition of algebra: "[it is concerned] with operating on unknowns using all the arithmetical tools, in the same way as the arithmetician operates on the known."

- **1135**: Sharaf al-Dīn al-Ṭūsī. Follows al-Khayyam's application of algebra of geometry, rather than follow the general development that came through al-Karaji's school of algebra. Wrote a treatise on cubic equations which describes thus: "[the treatise] represents an essential contribution to another algebra which aimed to study curves by means of equations, thus inaugurating the beginning of algebraic geometry."

**Thirteenth Century**

Chemistry

- Al-Jawbari describes the preparation of rose water in the work "Book of Selected Disclosure of Secrets" (Kitab kashf al-Asrar).
- Materials; glassmaking: Arabic manuscript on the manufacture of false gemstones and diamonds. Also describes spirits of alum, spirits of saltpetre and spirits of salts (hydrochloric acid).
- An Arabic manuscript written in Syriac script gives description of various chemical materials and their properties such as sulfuric acid, sal-ammoniac, saltpetre and zaj (vitriol).

Mathematics

- **1260**: al-Farisi. Gave a new proof of Thabit ibn Qurra's theorem, introducing important new ideas concerning factorization and combinatorial methods. He also gave the pair of amicable numbers 17296, 18416 which have also been joint attributed to Fermat as well as Thabit ibn Qurra.

Miscellaneous

- Mechanical engineering: Ismail al-Jazari described 100 mechanical devices, some 80 of which are trick vessels of various kinds, along with instructions on how to construct them
- Medicine; Scientific method: Ibn Al-Nafis (1213-1288) Damascene physician and anatomist. Discovered the lesser circulatory system (the cycle involving the ventricles of the heart and the lungs), and described the mechanism of breathing and its relation to the blood and how it nourishes on air in the lungs. Followed a "constructivist" path of the smaller circulatory system: "blood is purified in the lungs for the continuance of life and providing the body with the ability to work". During his time, the common view was that blood originates in the liver then travels to the right ventricle, then on to the organs of the body; another
contemporary view was that blood is filtered through the diaphragm where it mixes with the air coming from the lungs. Ibn al-Nafis discredited all these views including ones by Galen and Avicenna (ibn Sina). At least an illustration of his manuscript is still extant. William Harvey explained the circulatory system without reference to ibn al-Nafis in 1628. Ibn al-Nafis extolled the study of comparative anatomy in his "Explaining the dissection of [Avicenna's] Al-Qanoon" which includes a prefaces, and citations of sources. Emphasized the rigours of verification by measurement, observation and experiment. Subjected conventional wisdom of his time to a critical review and verified it with experiment and observation, discarding errors.

**Fourteenth Century**

**Astronomy**

- **1393–1449**: Ulugh Beg commissions an observatory at Samarqand in present-day Uzbekistan.

**Mathematics**

- **1380–1429**: al-Kashi. According to, "contributed to the development of decimal fractions not only for approximating algebraic numbers, but also for real numbers such as pi. His contribution to decimal fractions is so major that for many years he was considered as their inventor. Although not the first to do so, al-Kashi gave an algorithm for calculating nth roots which is a special case of the methods given many centuries later by Ruffini and Horner."

**Fifteenth Century**

**Mathematics**

- Ibn al-Banna and al-Qalasadi used symbols for mathematics "and, although we do not know exactly when their use began, we know that symbols were used at least a century before this."

**Miscellaneous**

- Astronomy and mathematics: Ibn Masoud (Ghayyathuddin Jamshid ibn Mohamed ibn mas’oud, d. 1424 or 1436.) Wrote on the decimal system. Computed and observed the solar eclipses of 809AH, 810AH and 811AH, after being invited by Ulugh Beg, based in Samarqand to pursue his study of mathematics, astronomy and physics. His works include "The Key of arithmetics"; "Discoveries in mathematics"; "The Decimal point"; "the benefits of the zero". The contents of the Benefits of the Zero are an introduction followed by five essays: On whole number arithmetic; On fractional arithmetic; on astrology; on areas; on...
finding the unknowns [unknown variables]. He also wrote a "Thesis on the sine and the chord"; "thesis on the circumference" in which he found the ratio of the circumference to the radius of a circle to sixteen decimal places; "The garden of gardens" or "promenade of the gardens" describing an instrument he devised and used at the Samarqand observatory to compile an ephemeris, and for computing solar and lunar eclipses; The ephemeris "Zayj Al-Khaqani" which also includes mathematical tables and corrections of the ephemeris by Al-Tusi; "Thesis on finding the first degree sine".

Seventeenth century

Mathematics

- The Arabic mathematician Mohammed Baqir Yazdi discovered the pair of amicable numbers 9,363,584 and 9,437,056 for which he is jointly credited with Descartes.

Timeline of psychotherapy

- c. 1550 BCE – Ancient Egyptians codified their knowledge of psychiatry, medicine, and surgery in the Ebers Papyrus and the Edwin Smith Papyrus. The former mentioned dementia and depression, while the latter gave detailed instructions for various neurosurgical procedures. The power of magic (suggestion) was recognized as complementary to medicine.
- c. 500 BCE – Siddhartha Gautama (Lumbini, Nepal) founded the psychotherapeutic practices of Buddhism on the principle that the origin of mental suffering is ignorance, that the symptoms of ignorance are attachment and craving, and that attachment and craving can be ended by following the Eightfold Path.
- c. 400 BCE – Hippocrates (Kos, Greece) taught that melancholia (depression) has a biological cause, namely an excess of black bile, one of the four humours. Ancient Greek therapy for disorders of mood involved adjustment of the humours, to bring them into balance.
- c. 300 BCE – Composition of the Huangdi Neijing began in China. This medical work emphasized the relationship between organs and emotions, and formalized the theory of Qi (life-force) and the balancing of the primal forces of Yin and yang.
- c. 900 – Ahmed ibn Sahl al-Balkhi (Balkh, Afghanistan) introduces the concepts of mental health or "mental hygiene". He also recognized that illnesses can have both psychological and/or physiological causes.
- c. 900 – al-Razi (Rhazes) recognized the concept of "psychotherapy" and referred to it as al-‘ilaj al-nafs.
• 1025 – Avicenna (Bukhara Region, Uzbekistan) In The Canon of Medicine, he described a number of conditions, including hallucination, insomnia, mania, nightmare, melancholia, dementia, epilepsy, paralysis, stroke, vertigo and tremor.

• c. 1150 – Ibn Zuhr, aka 'Avenzoar" (Seville, Spain), a Muslim Arab physician and surgeon, gave the first accurate descriptions on certain neurological disorders such as meningitis, intracranial thrombophlebitis, and mediastinal germ cell tumors.

• c. 1150 – Averroes suggested the existence of Parkinson's disease.

• c. 1200 – Maimonides wrote about neuropsychiatric disorders and described rabies and belladonna intoxication.

• 1403 – The Bethlem Royal Hospital of London, (Bedlam) (established as a hospital in 1330) admitted its first mentally ill patients. The care amounted to little more than restraint.

• 1567 – Philippus Aureolus Theophrastus Bombastus von Hohenheim, aka "Paracelsus" (Einsiedeln, Switzerland) edited as providing the first clinical/scientific mention of the unconscious in his work Von den Krankheiten. Paracelsus called for the humane treatment of the mentally ill (but was ignored for several centuries) as he saw them not to be possessed by evil spirits, but merely 'brothers' ensnared in a treatable malady.

• 1770 – Johann Joseph Gassner initiated a therapeutic practice using a precursor of hypnotherapy and exorcism.

• 1774 – Franz Mesmer described the therapeutic properties of "animal magnetism" (hypnotherapy), and began a clinical practice.

• 1785 – Marquis de Puységur founded the Société Harmonique des Amis Réunis to train specialists in Mesmerism (hypnotherapy).

• 1793 – Jean-Baptiste Pussin, working with Philippe Pinel, took over France's Bicetre Hospital and began releasing incarcerated mental patients from chains and iron shackles in the first movement for the humane treatment of the mentally ill. "The Moral Treatment" included humane, non-violent, and drug-free management of mental illness.

• 1801 – Philippe Pinel (France) published the first psychological approach to the treatment of the insane. The work appeared in English translation in 1806, as Treatise on Insanity.

• 1813 – Abbé Faria identified the central role of suggestion in "animal magnetism" (hypnotherapy).

• 1826 – Justinus Kerner began treatment of patients with a combination of "animal magnetism" (hypnotherapy) and exorcism.
1870 – Jean-Martin Charcot began clinical research into hysteria (conversion disorder) at the Salpêtrière Hospital in Paris.

1884 – Jean-Martin Charcot explained demonic possession as a form of hysteria (conversion disorder), to be treated with hypnotherapy.

1885 – Pierre Janet began therapeutic practice and research in Le Havre.

1886 – Sigmund Freud began therapeutic practice and research in Vienna.

1892 – Foundation of the American Psychological Association (APA), headed by G. Stanley Hall.

1895 – Development of the first psychological clinic at the University of Pennsylvania, marking the birth of clinical psychology.

1898 – Boris Sidis publishes *The Psychology of Suggestion: A Research into the Subconscious Nature of Man and Society*.

1900 – Sigmund Freud published *Interpretation of Dreams*, marking the beginning of Psychoanalytic Thought.

1902 - In the autumn the Wednesday Psychological Society (*Psychologische Mittwochs-Gesellschaft*) started meeting in Freud's apartment in Vienna, marking the beginnings of the worldwide psychoanalytic movement.

1906 – The Journal of Abnormal Psychology founded by Morton Prince for which Boris Sidis was an associate editor and significant contributor.

1906 - The Child Guidance Movement begins in Chicago.

1906 - Carl Jung began correspondence with Freud.

1907 - Jung and his wife, Emma travelled to Vienna to meet with Freud.

1909 - Sandor Ferenczi, Freud and Jung travelled together to the United States to participate in the Clark University conference.

1910 - Freud proposes Jung as his "eldest son and heir" to his new science.

1910 – Boris Sidis opens the Sidis Psychotherapeutic Institute (a private hospital) at Maplewood Farms in Portsmouth, NH for the treatment of nervous patients using the latest scientific methods.

1911 – Alfred Adler left Freud's Psychoanalytic Group to form his own school of thought, Individual Psychology, accusing Freud of overemphasizing sexuality and basing his theory on his own childhood.

1912 - Publication of Jung's *Psychology of the Unconscious: a study of the transformations and symbolisms of the libido*, (subsequently republished as *Symbols of Transformation*), containing his dissenting view on the libido, it represented largely a "psychoanalytical Jung".
- 1913 – Carl Jung departed from Freudian views, a final break ensued and he developed his own theories citing Freud's inability to acknowledge religion and spirituality and his restricted view of libido. His "new school of thought" became known as Analytical Psychology.

- 1913 – Jacob L. Moreno applied Group Psychotherapy methods in Vienna. His methods, which emphasized spontaneity and interaction, later became known as Psychodrama and Sociometry.

- 1914 – Boris Sidis publishes *The Foundations of Normal and Abnormal Psychology* where he provides the scientific foundation for the field of psychology, and details his theory of the *moment-consciousness*.

- 1919 - The British Psychoanalytical Society established by Ernest Jones in London.

- 1921 – Jacob L. Moreno conducted the first large scale public Psychodrama session at the Komoedienhaus, Vienna. He moved to New York in 1925.

- 1922 – Boris Sidis publishes *Nervous Ills: Their Cause and a Cure*, a popularization of his work concerning the subconscious and the treatment of psychopathic disease.

- 1933 – Wilhelm Reich published his influential book *Character Analysis* giving his view that a person's entire character, not only individual symptoms, could be looked at and treated as a neurotic phenomenon. The book also introduced his theory of body armoring.

- 1936 – Karen Horney began her critique of Freudian psychoanalytic theory with the publication of *Feminine Psychology*.

- 1936 – Saul Rosenzweig published his article *Some Implicit Common Factors in Diverse Methods of Psychotherapy*, in which he argued that common factors, rather than specific ingredients, cause change in psychotherapy.

- 1942 – Carl Rogers published *Counseling and Psychotherapy*, suggesting that respect and a non-judgmental approach to therapy is the foundation for effective treatment of mental health issues.

- 1943 – Albert Hofmann writes his first report about the hallucinogenic properties of LSD, which he first synthesized in 1938. LSD was practiced as a therapeutic drug throughout the 1950s and 1960s.

- 1945 - Society of Analytical Psychology incorporated in London

- 1945 – Orval Hobart Mowrer founded Integrity Groups therapy.

- 1945 – The *Journal of Clinical Psychology* was founded.

- 1949 – The Boulder Conference outlined the scientist-practitioner model of clinical psychology, looking at the master's degree versus PhD used by medical providers and researchers, respectively.

- 1951 – Carl Rogers published his major work, *Client-Centered Therapy*.


- 1951 - The Association of Psychotherapists established in London.
1952 – The Diagnostic and Statistical Manual of Mental Disorders (DSM) was published by The American Psychiatric Association marking the beginning of modern mental illness classification.

1953 – B.F. Skinner outlined behavioral therapy, lending support for behavioral psychology via research in the literature.

1953 – Code of Ethics for Psychologists developed by the American Psychological Association.

1954 – Abraham Maslow helped to found Humanistic psychology and later developed his famous Hierarchy of Needs.

1955 – Albert Ellis began teaching the methods of Rational Emotive Behavior Therapy the first form of cognitive psychotherapy.

1959 – Viktor Frankl published the first English edition of *Man's Search for Meaning* [with a preface by Gordon Allport], which provided an existential account of his Holocaust experience and an overview of his system of existential analysis called Logotherapy.


1960 – R. D. Laing published *The Divided Self* which saw mental illness as an expression or communication of the individual and so represented valid descriptions of lived experience or reality rather than as symptoms of some separate or underlying disorder.

1962 – The Esalen Institute founded at Big Sur California, acting as a focus for the development of many branches of Humanistic psychology.

1965 – William Glasser published *Reality Therapy*, describing his psycho-therapeutic model and introducing his concept of control theory [later renamed to Choice Theory].

1967 – Aaron Beck published a psychological model of depression, suggesting that thoughts play a significant role in the development and maintenance of depression.


1969 – California School of Professional Psychology established as first freestanding school of professional psychology.


1971 – Vladimir Bukovsky documented the psychiatric imprisonment of political prisoners in the USSR.


1990 – Michael White and David Epston publish *Narrative Means to Therapeutic Ends*, the first major text in what later comes to be known as narrative therapy.

1991 – The American Psychoanalytic Association passed a resolution opposing "public or private discrimination" against homosexuals. It stopped short, however, of agreeing to open its training institutes to these individuals.

1992 – The American Psychoanalytic Association extended the provisions of its 1991 resolution (see above) to training candidates at its affiliated institutes.

1994 – DSM IV (The Diagnostic and Statistical Manual of Mental Disorders) published by the American Psychiatric Association.

1997 – The American Psychoanalytic Association became the first national mental health organization to support same-sex marriage.

2000 – The DSM-IV-TR, was published in May 2000 in order to correct several errors in DSM-IV, and to update and change diagnostic codes to reflect the ICD-9-CM coding system.

2013 – The Fifth Edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) was released at the American Psychiatric Association’s Annual Meeting in May 2013, marking the end of more than a decade’s journey in revising the criteria for the diagnosis and classification of mental disorders.

**Timeline of astronomical maps, catalogs, and surveys**

- c. 1800 BC — Babylonian star catalog (see Babylonian star catalogues)
- c. 1370 BC — Observations for the Babylonia MUL.APIN (an astro catalog).
- c. 350 BC — Shi Shen’s star catalog has almost 800 entries
- c. 300 BC — star catalog of Timocharis of Alexandria
- c. 134 BC — Hipparchus makes a detailed star map
- c. 140 — Ptolemy completes his *Almagest*, which contains a catalog of stars, observations of planetary motions, and treatises on geometry and cosmology
- c. 705 — Dunhuang Star Chart, a manuscript star chart from the Mogao Caves at Dunhuang
- c. 750 — The first Zij treatise, *Az-Zij alā Sinī al-’Arab*, written by Ibrahim al-Fazari and Muhammad al-Fazari
- c. 777 — Yaqūb ibn Tāriq’s *Az-Zij al-Mahlul min as-Sindhind li-Darajat Daraja*
- c. 830 — Muhammad ibn Mūsā al-Khwārizmi’s *Zij al-Sindhind*
- c. 840 — Ahmad ibn Muhammad ibn Kathīr al-Farghānī’s *Compendium of the Science of the Stars*
- c. 900 — Muhammad ibn Jābir al-Harrānī al-Battānī’s *Az-Zij as-Sabi*
Abd al-Rahman al-Sufi (Azophi)'s star catalog *Book of the Fixed Stars*

Abū Rayhān al-Bīrūnī's *al-Qanun al-Mas'ūdi*, making first use of a planisphere projection, and discussing the use of the astrolabe and the armillary sphere.

The first almanac is the *Almanac of Azarqueil* written by Abū Ishāq Ibrāhīm al-Zarqālī (Azarqueil)

Al-Khazinī's *Az-Zij as-Sinjarī* (*Sinjaric Tables*)

c. 1150 — Gerard of Cremona publishes *Tables of Toledo* based on the work of Azarqueil

1252–1270 — *Alfonsine tables* recorded by order of Alfonso X

1272 — Nasīr al-Dīn al-Tūsī's *Zīj-i Ilkhanī* (*Ilkhanic Tables*)

1395 — Cheonsang Yeolcha Bunyajido star map created at the order of King Taejo

c. 1400 — Jamshīd al-Kāshī's *Khaqani Zīj*

1437 — Publication of Ulugh Beg's *Zīj-i-Sultānī*

1551 — Prussian Tables by Erasmus Reinhold

late 16th century — Tycho Brahe updates Ptolemy's *Almagest*

1577–1580 — Taqī al-Din's *Unbored Pearl*

1598 — Tycho Brahe publishes his "Thousand Star Catalog"

1603 — Johann Bayer's *Uranometria*

1627 — Johannes Kepler publishes his Rudolphine Tables of 1006 stars from Tycho plus 400 more

1678 — Edmund Halley publishes a catalog of 341 southern stars, the first systematic southern sky survey

1725 — Posthumous publication of John Flamsteed's *Historia Coelestis Britannica*

1771 — Charles Messier publishes his first list of nebulae

1824 — *Urania's Mirror* by Sidney Hall

1862 — Friedrich Wilhelm Argelander publishes his final edition of the *Bonner Durchmusterung* catalog of stars north of declination -1°.

1864 — John Herschel publishes the *General Catalogue* of nebulae and star clusters

1887 — Paris conference institutes *Carte du Ciel* project to map entire sky to 14th magnitude photographically

1890 — John Dreyer publishes the *New General Catalogue* of nebulae and star clusters

1932 — Harlow Shapley and Adelaide Ames publish *A Survey of the External Galaxies Brighter than the Thirteenth Magnitude*, later known as the *Shapley-Ames Catalog*
1948 — Antonin Bečvář publishes the *Skalnate Pleso Atlas of the Heavens (Atlas Coeli Skalnaté Pleso 1950.0)*

1950–1957 — Completion of the Palomar Observatory Sky Survey (POSS) with the Palomar 48-inch Schmidt optical reflecting telescope. Actual date quoted varies upon source.

1962 — A.S. Bennett of the Cambridge Radio Astronomy Group publishes the Revised 3C Catalogue of 328 radio sources

1965 — Gerry Neugebauer and Robert Leighton begin a 2.2 micrometre sky survey with a 1.6-meter telescope on Mount Wilson

1982 — IRAS space observatory completes an all-sky mid-infrared survey

1990 — Publication of APM Galaxy Survey of 2+ million galaxies, to study large-scale structure of the cosmos

1991 — ROSAT space observatory begins an all-sky X-ray survey

1993 — Start of the 20 cm VLA FIRST survey

1997 — Two Micron All Sky Survey (2MASS) commences, first version of Hipparcos Catalogue published

1998 — Sloan Digital Sky Survey commences

2003 — 2dF Galaxy Redshift Survey published; 2MASS completes

2012 — On March 14, 2012, a new atlas and catalog of the entire infrared sky as imaged by Wide-field Infrared Survey Explorer was released.

**Timeline of Solar System astronomy**

- 2nd millennium BC – earliest possible date for the composition of the Babylonian Venus tablet of Ammisaduqa, a 7th-century BC copy of a list of observations of the motions of the planet Venus, and the oldest planetary table currently known.

- 2nd millennium BC – Babylonian astronomers identify the inner planets Mercury and Venus and the outer planets Mars, Jupiter and Saturn, which would remain the only known planets until the invention of the telescope in early modern times.

- late 2nd millennium BC – Chinese astronomers record a solar eclipse

- late 2nd millennium BC – Chinese determine that Jupiter needs 12 years to complete one revolution of its orbit.

- c. 1100 BC – Chinese first determine the spring equinox.

- 776 BC – Chinese make the earliest reliable record of a solar eclipse.
• 7th century BC – Egyptian astronomers alleged to have predicted a solar eclipse
• 613 BC, July – A Comet, possibly Comet Halley, is recorded in Spring and Autumn Annals by the Chinese
• 586 BC – Thales of Miletus alleged to have predicted a solar eclipse
• c. 450 BC: Anaxagoras shows that the Moon shines by reflected sunlight.
• 350 BC – Aristotle argues for a spherical Earth using lunar eclipses and other observations
• 280 BC – Aristarchus of Samos offers the first definite discussion of the possibility of a heliocentric cosmos, and uses the size of the Earth's shadow on the Moon to estimate the Moon's orbital radius at 60 Earth radii, and its physical radius as one-third that of the Earth. He also makes an inaccurate attempt to measure the distance to the Sun
• 200 BC – Eratosthenes determines that the radius of the Earth is roughly 6,400 km
• 150 BC – Hipparchus uses parallax to determine that the distance to the Moon is roughly 380,000 km
• 134 BC – Hipparchus discovers the precession of the equinoxes
• 87 BC — The Antikythera mechanism, the earliest known computer, is built. It is designed to predict the movements of the Planets.
• 28 BC – Chinese history book Book of Han makes earliest known dated record of sunspot.
• c. 150 CE – Claudius Ptolemy completes his Almagest that codifies the astronomical knowledge of his time and cements the geocentric model in the West
• 499 – The Indian astronomer-mathematician, Aryabhata, in his *Aryabhatiya*, propounds a possibly heliocentric solar system of gravitation, and an eccentric epicyclic model of the planets, where the planets follow elliptical orbits around the Sun, and the Moon and planets shine by reflected sunlight
• 500 – Aryabhata accurately computes the Earth's circumference, the solar and lunar eclipses, and the length of Earth's revolution around the Sun
• 620s – Indian mathematician-astronomer Brahmagupta recognizes gravity as a force of attraction, and briefly describes a law of gravitation
• 628 – Brahmagupta gives methods for calculations of the motions and places of various planets, their rising and setting, conjunctions, and calculations of the solar and lunar eclipses
• 687 – Chinese make earliest known record of meteor shower
• 9th century – The eldest Banū Mūsā brother, Ja'far Muhammad ibn Mūsā ibn Shākir, hypothesizes that the heavenly bodies and celestial spheres are subject to the same laws of physics as Earth, and proposes that there is a force of attraction between heavenly bodies
• 820 – the Persian astronomer, Muhammad ibn Musa al-Khwarizmi, composes his Zij astronomical tables, utilising Arabic numerals and the Hindu-Arabic numeral system in his calculations
850 – Ahmad ibn Muhammad ibn Kathîr al-Farghânî (Alfraganus) gives values for the obliquity of the ecliptic, the precessional movement of the apogees of the Sun

10th century – Muhammad ibn Jâbir al-Harrânî al-Battânî (Albatenius) discovers that the direction of the Sun's eccentricity is changing

900s (decade) – Ibn Yunus observes more than 10,000 entries for the Sun's position for many years using a large astrolabe with a diameter of nearly 1.4 metres

1019 – Abû Rayhân al-Bîrûnî observes and describes the solar eclipse on April 8 and the lunar eclipse on September 17 in detail, and gives the exact latitudes of the stars during the lunar eclipse

1031 – Abû Rayhân al-Bîrûnî calculates the distance between the Earth and the Sun in his Canon Mas’ūdīus

1150 – Indian mathematician-astronomer Bhâskara II, in the Siddhanta Shiromani, calculates the longitudes and latitudes of the planets, lunar and solar eclipses, risings and settings, the Moon's lunar crescent, syzygies, and conjunctions of the planets with each other and with the fixed stars, and explains the three problems of diurnal rotation

1150s – Bhaskara calculates the planetary mean motion, ellipses, first visibilities of the planets, the lunar crescent, the seasons, and the length of the Earth's revolution around the Sun to 9 decimal places.

1150s – Gerard of Cremona translates Ptolemy's Almagest from Arabic into Latin, eventually leading to its adoption by the Catholic Church as an approved text.

c. 1200 – Fakhr al-Din al-Razi, in dealing with his conception of physics and the physical world, rejected the Aristotelian and Avicennian view of a single world, but instead proposed that there are "a thousand thousand worlds (alfa alfi 'awalim) beyond this world such that each one of those worlds be bigger and more massive than this world as well as having the like of what this world has."

c. 1300 – Ibn Qayyim Al-Jawziyya, in his criticism of astrology, recognized that the stars are much larger than the planets, and that Mercury is the smallest planet known to him.

c. 1350 – Ibn al-Shatîr anticipates Copernicus by abandoning the equant of Ptolemy in his calculations of planetary motion, and he provides the first empirical model of lunar motion which accurately matches observations.

c. 1514 – Nicolaus Copernicus states his heliocentric theory in Commentariolus

1522 – First circumnavigation of the world by Magellan-Elcano expedition shows that the Earth is, in effect, a sphere.

1543 – Copernicus publishes his heliocentric theory in De revolutionibus orbium coelestium

c. 1570 – Tycho Brahe founds the first modern astronomical observatory.

1577 – Tycho Brahe uses parallax to prove that comets are distant entities and not atmospheric phenomena.
- 1609 – Johannes Kepler states his first two empirical laws of planetary motion, stating that the orbits of the planets are elliptical rather than circular, and thus resolving many ancient problems with planetary models.
- 1610 – Galileo Galilei discovers Callisto, Europa, Ganymede, and Io, sees Saturn's planetary rings (but does not recognize that they are rings), and observes the phases of Venus, disproving the Ptolemaic system, though not the geocentric model
- 1619 – Johannes Kepler states his third empirical law of planetary motion
- 1655 – Giovanni Domenico Cassini discovers Jupiter's Great Red Spot
- 1656 – Christiaan Huygens identifies Saturn's rings as rings and discovers Titan
- 1665 – Cassini determines the rotational speeds of Jupiter, Mars, and Venus
- 1672 – Cassini discovers Iapetus and Rhea
- 1672 – Jean Richer and Cassini measure the astronomical unit to be about 138,370,000 km
- 1675 – Ole Rømer uses the orbital mechanics of Jupiter's moons to estimate that the speed of light is about 227,000 km/s
- 1686 – Cassini discovers Tethys and Dione
- 1705 – Edmond Halley publicly predicts the periodicity of Halley's Comet and computes its expected path of return in 1757
- 1715 – Edmond Halley calculates the shadow path of a solar eclipse
- 1716 – Edmond Halley suggests a high-precision measurement of the Sun-Earth distance by timing the transit of Venus
- 1718 – Edmond Halley discovers proper motion, dispelling the concept of the "fixed stars".
- 1729 – James Bradley determines the cause of the aberration of starlight, providing the first direct evidence of the Earth's motion.
- 1735-1739 – The French Academy of Sciences sent two expeditions in order to measure the roundness of the Earth by measuring the length of a degree of latitude at two locations, one to Lapland, close to the Arctic Circle and other to the Equator, the French Geodesic Mission, which prove that the Earth is oblate.
- 1755 – Immanuel Kant first formulates the nebular hypothesis of Solar System formation.
- 1758 – Johann Palitzsch observes the return of Halley's comet. The interference of Jupiter's orbit had slowed the return by 618 days. Parisian astronomer La Caille suggests it should be named Halley's comet.
- 1766 – Johann Titius finds the Titius-Bode rule for planetary distances
- 1772 – Johann Bode publicizes the Titius-Bode rule for planetary distances
- 1781 – William Herschel discovers Uranus during a telescopic survey of the northern sky
- 1787 – Herschel discovers Uranus's moons Titania and Oberon
• 1789 – Herschel discovers Saturn's moons Enceladus and Mimas
• 1796 – Pierre Laplace re-states the nebular hypothesis for the formation of the Solar System from a spinning nebula of gas and dust
• 1801 – Giuseppe Piazzi discovers the dwarf planet–asteroid Ceres
• 1802 – Heinrich Wilhelm Olbers discovers the asteroid Pallas
• 1821 – Alexis Bouvard detects irregularities in the orbit of Uranus
• 1825 – Pierre Laplace completes his study of gravitation, the stability of the Solar System, tides, the precession of the equinoxes, the libration of the Moon, and Saturn's rings in *Mécanique Céleste*
• 1838 – Friedrich Wilhelm Bessel measures the parallax of the star 61 Cygni, refuting one of the oldest arguments against heliocentrism.
• 1840 — John W. Draper takes a daguerreotype of the Moon, the first astronomical photograph.
• 1843 – John Adams predicts the existence and location of Neptune from irregularities in the orbit of Uranus
• 1846 – Urbain Le Verrier predicts the existence and location of Neptune from irregularities in the orbit of Uranus
• 1846 – Johann Galle discovers Neptune
• 1846 – William Lassell discovers Triton
• 1848 – Lassell, William Cranch Bond and George Phillips Bond discover Saturn's moon Hyperion
• 1849 – Édouard Roche finds the limiting radius of tidal destruction and tidal creation for a body held together only by its self gravity, called the Roche limit, and uses it to explain why Saturn's rings do not condense into a satellite
• 1851 – Lassell discovers Uranus's moons Ariel and Umbriel
• 1856 – James Clerk Maxwell demonstrates that a solid ring around Saturn would be torn apart by gravitational forces and argues that Saturn's rings consist of a multitude of tiny satellites
• 1862 – By analysing the spectroscopic signature of the Sun and comparing it to those of other stars, Father Angelo Secchi determines that the Sun is itself a star.
• 1866 – Giovanni Schiaparelli realizes that meteor streams occur when the Earth passes through the orbit of a comet that has left debris along its path
• 1877 – Asaph Hall discovers Mars's moons Deimos and Phobos
• 1892 – Edward Emerson Barnard discovers Jupiter's moon Amalthea
• 1899 – William Henry Pickering discovers Saturn's moon Phoebe
• 1906 – Max Wolf discovers the Trojan asteroid Achilles
• 1915 – Robert Innes discovers Proxima Centauri, the closest star to Earth after the Sun
• 1919 – Arthur Stanley Eddington uses a solar eclipse to successfully test Albert Einstein's General Theory of Relativity
• 1930 – Clyde Tombaugh discovers Pluto
• 1930 – Seth Nicholson measures the surface temperature of the Moon
• 1935 — The Explorer II balloon reached a record altitude of 22,066 m (72,395 ft), enabling its occupants to photograph the curvature of the Earth for the first time.
• 1944 – Gerard Kuiper discovers that the satellite Titan has a substantial atmosphere
• 1946 – American launch of a camera-equipped V-2 rocket provides the first image of the Earth from space
• 1949 – Gerard Kuiper discovers Uranus's moon Miranda and Neptune's moon Nereid
• 1950 – Jan Oort suggests the presence of a cometary Oort cloud
• 1951 – Kuiper argues for an annular reservoir of comets between 40-100 astronomical units from the Sun, the Kuiper belt
• 1959 — Explorer 6 sends the first image of the entire earth from Space.
• 1959 – Luna 3 sends the first images of another celestial body, the Moon, from space, including its unseen far side.
• 1962 – The Mariner 2 Venus flyby performs the first closeup observations of another planet
• 1964 – The Mariner 4 spacecraft provides the first detailed images of the surface of Mars
• 1966 – The Luna 9 Moon lander provides the first images from the surface of another celestial body
• 1967 – Venera 4 provides the first information on Venus's atmosphere
• 1968 – The Apollo 8 becomes the first manned lunar mission, providing historic images of the whole Earth.
• 1970 – The Venera 7 Venus lander sends back the first information ever successfully obtained from the surface of another planet
• 1971 – The Mariner 9 Mars spacecraft becomes the first to successfully orbit another planet. It provides the first detailed maps of the Martian surface, discovering much of the planet's topography, including the volcano Olympus Mons and the canyon system Valles Marineris, which is named in its honor.
• 1971 – Mars 3 lands on Mars, and transmits the first partial image from the surface of another planet.
• 1973 – Skylab astronauts discover the Sun's coronal holes.
• 1973 – Pioneer 10 flies by Jupiter, providing the first closeup images of the planet and revealing its intense radiation belts.
• 1973 — Mariner 10 provides the first closeup images of the clouds of Venus.
• 1974 – Mariner 10 provides the first closeup images of the surface of Mercury.
• 1975 – Venera 9 becomes the first probe to successfully transmit images from the surface of Venus.
• 1977 – James Elliot discovers the rings of Uranus during a stellar occultation experiment on the Kuiper Airborne Observatory
• 1977 – Charles Kowal discovers 2060 Chiron, the first Centaur
• 1978 – James Christy discovers Charon, the large moon of Pluto.
• 1978 – The Pioneer Venus probe maps the surface of Venus.
• 1978 – Peter Goldreich and Scott Tremaine present a Boltzmann equation model of planetary-ring dynamics for indestructible spherical ring particles that do not self-gravitate and find a stability requirement relation between ring optical depth and particle normal restitution coefficient
• 1979 – Pioneer 11 flies by Saturn, providing the first ever closeup images of the planet and its rings. It discovers the planet's F ring and determines that its moon Titan has a thick atmosphere.
• 1979 – Voyager 1 flies by Jupiter and discovers its faint ring system, as well as volcanoes on Io, the innermost of its Galilean moons.
• 1979 – Voyager 2 flies by Jupiter and discovers evidence of an ocean under the surface of its moon Europa.
• 1980 – Voyager 1 flies by Saturn and takes the first images of Titan. However, its atmosphere is opaque to visible light, so its surface remains obscured.
• 1986 – Voyager 2 provides the first ever detailed images of Uranus, its moons and rings.
• 1986 – The Giotto probe provides the first ever close up images of Halley's Comet.
• 1988 – Martin Duncan, Thomas Quinn, and Scott Tremaine demonstrate that short-period comets come primarily from the Kuiper Belt and not the Oort cloud
• 1989 – Voyager 2 provides the first ever detailed images of Neptune, its moons and rings.
• 1990 – The Hubble Space Telescope is launched
• 1990 – Voyager 1 is turned around to take the Portrait of the Planets of the Solar System, source of the Pale Blue Dot image of the Earth
• 1991 – The Magellan spacecraft maps the surface of Venus.
• 1992 – First planetary system beyond the Solar System detected, around the pulsar PSR B1257+12
• 1992 – David Jewitt and Jane Luu of the University of Hawaii discover 15760 Albion, the first object deemed to be a member of the Kuiper belt
• 1995 – The first planet around a Sun-like star is discovered, in orbit around the star 51 Pegasi.
• 1995 – The Galileo spacecraft becomes the first to orbit Jupiter. Its atmospheric entry probe provides the first data taken within the planet itself.
• 2000 – NEAR Shoemaker provides the first detailed images of a near-Earth asteroid.
• 2003 – Sedna, a large object with an unprecedented 12,000-year orbit, is discovered by Michael E. Brown, Chad Trujillo, and David L. Rabinowitz.
- 2004 – Voyager 1 sends back the first data ever obtained from within the Solar System's heliosheath.
- 2004 – The Cassini–Huygens spacecraft becomes the first to orbit Saturn. It discovers complex motions in the rings, several new small moons and cryovolcanism on the moon Enceladus and provides the first images from the surface of Titan.
- 2005 – Michael E. Brown et al. discover Eris, a trans-Neptunian object more massive than Pluto, and later also its moon, Dysnomia. Eris was first imaged in 2003, and is the most massive object discovered in the Solar System since Neptune's moon Triton in 1846.
- 2005 – The Mars Exploration Rovers perform the first astronomical observations ever taken from the surface of another planet, imaging an eclipse by Mars's moon Phobos.
- 2006 – The 26th General Assembly of the IAU voted in favor of a revised definition of a planet and officially declared Ceres, Pluto, and Eris dwarf planets.
- 2008 – The IAU declares Makemake and Haumea dwarf planets.
- 2011 – The Dawn spacecraft enters orbit around the large asteroid Vesta making detailed measurements.
- 2012 – Saturn's moon Methone is imaged up close by the Cassini spacecraft, revealing a remarkably smooth surface.
- 2012 – The Dawn spacecraft breaks orbit of Vesta and heads for Ceres.
- 2013 – The MESSENGER spacecraft provides the first ever complete map of the surface of Mercury
- 2015 – The Dawn spacecraft enters orbit around the dwarf Planet Ceres making detailed measurements.
- 2015 – The New Horizons spacecraft flies by Pluto, providing the first ever sharp images of its surface.
- 2017 – 'Oumuamua, the first known interstellar object, is identified.
- 2019 – 2I/Borisov, the first interstellar comet and second interstellar object, is discovered

**Timeline of cancer treatment development**

- 2600 BC – Egyptian physician Imhotep recommended producing a localised infection to promote regression of tumours. According to the Ebers medical papyrus, this was done by placing a poultice near the tumour, followed by local incision.
- BC – Ancient Greeks, Romans, and Egyptians used heat to treat masses. Healers in ancient India used regional and whole-body hyperthermia as treatments.
- 2 AD – Ancient Greeks describe surgical treatment of cancer.
- 1820s – British Dr. James Arnott, "the father of modern cryosurgery", starts to use cryotherapy to freeze tumours in the treatment of breast and uterine cancers
- 1866 – French Dr. Victor Despeignes, "the father of radiation therapy", starts to use X-rays to treat cancer
- 1880s – American Dr. William Stewart Halsted develops radical mastectomy for breast cancer
- 1890s – German Dr. Westermark used localized hyperthermia to produce tumour regression in patients
- 1891 – American Dr. William B. Coley, "the father of immunotherapy", starts to treat cancer patients by injecting them with streptococci, containing immunostimulatory CpG motifs
- 1896 – American Dr. Emil Grubbe starts to treat breast cancer patients with X-rays
- 1900 – Swedish Dr. Stenbeck cures a skin cancer with small doses of radiation
- 1920s – Dr. William B. Coley's immunotherapy treatment, regressed tumors in hundreds of cases, the success of Coley's Toxins attracted heavy resistance from his rival and supervisor, Dr. James Ewing, who was a fanatical supporter of radiation therapy for cancer. This rivalry and opposition to Dr. Coley leads to the disuse of immunotherapy for cancer, in favor of Dr. Ewing's preferred radiation therapy
- 1939 – American Dr. Charles Huggins uses synthetic hormone therapy to treat prostate cancer
- 1942 – First chemotherapy drug mustine used to treat cancer
- 1947 – American Dr. Sidney Farber induces brief remission in a patient with leukaemia with the antifolate drug aminopterin (methotrexate)
- 1949 – US FDA approves mechloretamine, a nitrogen mustard compound, for treatment of cancer
- 1949 – Oncolytic viruses began human clinical trials
- 1951 – Dr. Jane C. Wright demonstrated the use of the antifolate, methotrexate in solid tumors, showing remission in breast cancer
- 1953 – US FDA approves Mercaptopurine (6 MP), an immunosuppressive agent
- 1956 – Metastatic choriocarcinoma cancer is cured with the antifolate, methotrexate
- 1957 – Introduction of fluorouracil to treat colorectal, breast, stomach, and pancreatic cancers
- 1957 – Introduction of interferon to treat kidney, skin, and bladder cancer
- 1958 – Combination therapy consisting of 6-mercaptopurine and methotrexate results in a cure of leukaemia in a trial run in US hospitals
- 1958 – US FDA approves cyclophosphamide for chemotherapy of cancer
- 1960s – Introduction of laser therapy in treatment of cancer
- 1960 – Invention of tamoxifen breast cancer anti-estrogen (SERM) hormonal therapy drug
- 1961 – Vincristine, anti-cancer alkaloid, isolated from the Madagascar periwinkle plant
• 1962 – US FDA disapproves Dr. Coley's immunotherapy, making it illegal; radiation therapy remained the dominant treatment for cancer
• 1963 – US FDA approves vincristine (Oncovin) for chemotherapy of cancer
• 1964 – VAMP regimen combination therapy, consisting of: vincristine, amethopterin, 6-mercaptopurine, and prednisone, induces long-term remissions in juvenile acute lymphoblastic leukemia
• 1965 – MOPP regimen combination therapy cures advanced Hodgkin's lymphoma, with the combination of: nitrogen mustard, vincristine, procarbazine, and prednisone
• 1965 – MOMP regimen combination therapy, consisting of: methotrexate, vincristine, 6-MP, and prednisone, induces long-term remissions in juvenile acute lymphoblastic leukemia
• 1965 – Latvian scientist Aina Muceniece identifies echovirus as a potential agent for oncolytic virotherapy, resulting in the development of RIGVIR
• 1966 – Taxol, anti-cancer compound, isolated from the yew plant
• 1967 – Camptothecin, anti-cancer compound, isolated from the Camptotheca acuminata, the Chinese Happy Tree, which was used as a cancer treatment in traditional Chinese medicine. It is the source of chemotherapy drugs: topotecan and irinotecan.
• 1968 – Japanese Dr. Tanaka pioneers the treatment of metastatic breast cancer with cryoablation, resulting in prolonged survival
• 1972 – UK and other European countries approve tamoxifen for breast cancer
• 1972 – American Dr. Lawrence Einhorn cures metastatic testicular cancer with cisplatin
• 1975 – Invention of monoclonal antibodies
• 1975 – American Dr. Einhorn shows combination therapy consisting of cisplatinum, vinblastine, and bleomycin can cure 70% of advanced testicular cancer cases
• 1975 – C-MOPP regimen combination therapy, consisting of: methotrexate, vincristine, cyclophosphamide, and prednisone, cured advanced diffuse large B-cell lymphoma
• 1977 – US FDA approves tamoxifen for metastatic breast cancer only, not widely popular as chemotherapy remains first line of treatment
• 1981 – American Dr. Bernard Fisher proves lumpectomy is as effective as mastectomy for breast cancer
• 1989 – US FDA approves Carboplatin, a derivative of cisplatin, for chemotherapy
• 1990 – US FDA approves tamoxifen for major additional use to help prevent the recurrence of cancer in "node-negative" patients
• 1990 – China begins treating various cancers with photodynamic therapy
• 1991 – First gene therapy treatment of cancer (melanoma)
• 1992 – Invention of tyrosine-kinase inhibitor Imatinib

• 1992 – Invention of Etacstil breast cancer anti-estrogen (SERM/SERD) hormonal therapy drug that overcomes hormone-therapy resistance

• 1996 – US FDA approves antiestrogen, aromatase inhibitor Anastrozole for advanced breast cancer

• 1996 – Russia begins treating various cancers with photodynamic therapy

• 1997 – First monoclonal antibody, Rituximab, is licensed

• 1997 – Chinese doctors start treating uterine fibroids, liver cancer, breast cancer, pancreatic cancer, bone tumours, and renal cancer with ultrasound imaging-guided High-intensity focused ultrasound

• 1998 – Chinese doctors start treating breast, kidney, lung, liver, prostate and bone cancer with imaging-guided cryoablation

• 1998 – US FDA approves herceptin, a monoclonal antibody for HER2 metastatic breast cancer

• 1998 – US FDA approves cryoablation for the treatment of prostate cancer

• 1998 – US FDA approves Camptothecin-analogue irinotecan for chemotherapy of cancer

• 1998 – US FDA approves tamoxifen to reduce breast cancer risk in high-risk patients

• 1998 – US FDA approves monoclonal antibody, Trastuzumab for advanced HER-2 breast cancer

• 1998 – Imaging-guided High-intensity focused ultrasound is approved for use in Europe for treatment of cancer

• 2001 – UK NICE approves taxol for chemotherapy of breast, ovarian, and non-small cell lung cancers

• 2002 – US FDA approves imatinib

• 2002 – Chinese FDA approves Gendicine, gene therapy for cancer

• 2002 – Corporate takeover of Dupont by BMS resulted in abandoning Etacstil breast cancer anti-estrogen (SERM/SERD) hormonal therapy drug that overcomes hormone-therapy resistance

• 2003 – American Dr. Peter Littrup starts to treat early and metastatic breast cancer with cryoablation

• 2004 – bevacizumab, the first approved drug to inhibit blood vessel formation by tumours, is licensed

• 2005 – US FDA approves taxol for chemotherapy of breast, pancreatic, and non-small cell lung cancers

• 2006 – US FDA approves herceptin

• 2007 – US FDA approves sorafenib

• 2007 – US FDA approves camptothecin-analogue topotecan for chemotherapy of cancer

• 2010 – US FDA approves immunotherapy, sipuleucel-T dendritic cell vaccine for advanced prostate cancer

• 2010 – China advances cryoimmunotherapy to treat breast, kidney, lung, liver, prostate and bone cancer
• 2011 – US FDA approves monoclonal antibody, Ipilimumab for advanced melanoma
• 2011 – Cuba develops and releases CimaVax-EGF, the first therapeutic cancer vaccine for lung cancer
• 2012 – Cuba develops and releases monoclonal antibody, Racotumomab, the therapeutic cancer vaccine for lung cancer
• 2015 – US FDA approves anti-CDK4/6, Palbociclib for advanced breast cancer
• 2015 – US FDA approves imaging-guided High-intensity focused ultrasound for prostate cancer

Timeline of white dwarfs, neutron stars, and supernovae

• 185 – Chinese astronomers become the first to record observations of a supernova, SN 185,
• 1006 – Ali ibn Ridwan and Chinese astronomers observe the brightest (magnitude −7.5) recorded supernova, SN 1006, which is observed in the constellation of Lupus,
• 1054 – Chinese, American Indian and Arab astronomers observe the SN 1054, the Crab Nebula supernova explosion,
• 1181 – Chinese astronomers observe the SN 1181 supernova,
• 1572 – Tycho Brahe discovers a supernova (SN 1572) in the constellation Cassiopeia,
• 1604 – Johannes Kepler's supernova, SN 1604, in Serpens is observed,
• 1862 – Alvan Graham Clark observes Sirius B,
• 1866 – William Huggins studies the spectrum of a nova and discovers that it is surrounded by a cloud of hydrogen,
• 1885 – A supernova, S Andromedae, is observed in the Andromeda Galaxy leading to recognition of supernovae as a distinct class of novae,
• 1910 – the spectrum of 40 Eridani B is observed, making it the first confirmed white dwarf,
• 1914 – Walter Sydney Adams determines an incredibly high density for Sirius B,
• 1926 – Ralph Fowler uses Fermi–Dirac statistics to explain white dwarf stars,
• 1930 – Subrahmanyan Chandrasekhar discovers the white dwarf maximum mass limit,
• 1933 – Fritz Zwicky and Walter Baade propose the neutron star idea and suggest that supernovae might be created by the collapse of normal stars to neutron stars—they also point out that such events can explain the cosmic ray background,
• 1939 – Robert Oppenheimer and George Volkoff calculate the first neutron star models,
• 1942 – J.J.L. Duyvendak, Nicholas Mayall, and Jan Oort deduce that the Crab Nebula is a remnant of the 1054 supernova observed by Chinese astronomers,
- 1958 – Evry Schatzman, Kent Harrison, Masami Wakano, and John Wheeler show that white dwarfs are unstable to inverse beta decay,
- 1962 – Riccardo Giacconi, Herbert Gursky, Frank Paolini, and Bruno Rossi discover Scorpius X-1,
- 1967 – Jocelyn Bell and Antony Hewish discover radio pulses from a pulsar, PSR B1919+21,
- 1967 – J.R. Harries, Kenneth G. McCracken, R.J. Francey, and A.G. Fenton discover the first X-ray transient (Cen X-2),
- 1968 – Thomas Gold proposes that pulsars are rotating neutron stars,
- 1969 – David Staelin, E.C. Reifenstein, William Cocke, Mike Disney, and Donald Taylor discover the Crab Nebula pulsar thus connecting supernovae, neutron stars, and pulsars,
- 1971 – Riccardo Giacconi, Herbert Gursky, Ed Kellogg, R. Levinson, E. Schreier, and H. Tananbaum discover 4.8 second X-ray pulsations from Centaurus X-3,
- 1972 - Charles Kowal discovers the Type Ia supernova SN 1972e in NGC 5253, which would be observed for more than a year and become the basis case for the type,
- 1974 – Russell Hulse and Joseph Taylor discover the binary pulsar PSR B1913+16,
- 1977 – Kip Thorne and Anna Żytkow present a detailed analysis of Thorne–Żytkow objects,
- 1982 – Donald Backer, Shrinivas Kulkarni, Carl Heiles, Michael Davis, and Miller Goss discover the millisecond pulsar PSR B1937+214,
- 1985 – Michiel van der Klis discovers 30 Hz quasi-periodic oscillations in GX 5-1,
- 1987 – Ian Shelton discovers SN 1987A in the Large Magellanic Cloud,
- 2003 – first double binary pulsar, PSR J0737-3039, discovered at Parkes Observatory,

Timeline of scientific discoveries

- 4th century BC – Mandragora (containing atropin) was described by Theophrastus in the fourth century B.C. for treatment of wounds, gout, and sleeplessness, and as a love potion. By the first century A.D. Dioscorides recognized wine of mandrake as an anaesthetic for treatment of pain or sleeplessness, to be given prior to surgery or cautery.
- 323–283 BC – Euclid: wrote a series of 13 books on geometry called The Elements
- 287-212 BC – Archimedes of Syracuse: derived an accurate approximation of pi, defined and investigating the spiral bearing his name, and creating a system using exponentiation for expressing very large numbers.
• 280 BC – Aristarchus of Samos: used a heliocentric, heliostatic model
• 150s BC – Seleucus of Seleucia: discovery of tides being caused by the moon
• 50 – Pliny the Elder wrote the Natural History
• 150s Ptolemy: produced the geocentric model of the solar system.
• 200s Galen: produced big contributions to medicine.
• Al-Kindi (Alkindus): refutation of the theory of the transmutation of metals
• Jabir ibn Hayyan: creation of several acids
• Muhammad ibn Zakariya al-Razi (Rhazes): refutation of Aristotelian classical elements and Galenic humorism; and discovery of measles and smallpox, and kerosene and distilled petroleum
• 984 – Ibn Sahl accurately describes the optics which became known as Snell's law of refraction
• 1021 – Ibn al-Haytham's Book of Optics. First use of controlled experiments and reproducibility of its results.
• 1020s – Avicenna's The Canon of Medicine
• 1054 – Various early astronomers observe supernova (modern designation SN 1054), later correlated to the Crab Nebula.
• Shen Kuo: Discovers the concepts of true north and magnetic declination. In addition, he develops the first theory of Geomorphology.
• 1121 – Al-Khazini: variation of gravitation and gravitational potential energy at a distance; the decrease of air density with altitude
• Ibn Bajjah (Avempace): discovery of reaction (precursor to Newton's third law of motion)
• Hibat Allah Abu'l-Barakat al-Baghdadi (Nathanel): relationship between force and acceleration (a vague foreshadowing of a fundamental law of classical mechanics and a precursor to Newton's second law of motion)
• Averroes: relationship between force, work and kinetic energy
• 1220–1235 – Robert Grosseteste: rudiments of the scientific method
• 1242 – Ibn al-Nafis: pulmonary circulation and circulatory system
• Theodoric of Freiberg: correct explanation of rainbow phenomenon
• William of Saint-Cloud: pioneering use of camera obscura to view solar eclipses
• Before 1327 – William of Ockham: Occam's Razor
• Oxford Calculators: the mean speed theorem
• Jean Buridan: theory of impetus
• Nicole Oresme: discovery of the curvature of light through atmospheric refraction
• 1494 – Luca Pacioli: first codification of the double-entry bookkeeping system, which slowly developed in previous centuries
• 1543 – Nicolaus Copernicus: heliocentric model
• 1543 – Vesalius: pioneering research into human anatomy
• 1552 – Michael Servetus: early research in Europe into pulmonary circulation
• 1570s – Tycho Brahe: detailed astronomical observations
• 1600 – William Gilbert: Earth's magnetic field
• 1608 – Invention of the telescope
• 1609 – Johannes Kepler: first two laws of planetary motion
• 1610 – Galileo Galilei: Sidereus Nuncius: telescopic observations
• 1614 – John Napier: use of logarithms for calculation
• 1619 – Johannes Kepler: third law of planetary motion
• 1628 – Willebrord Snellius: the law of refraction also known as Snell's law
• 1628 – William Harvey: blood circulation
• 1638 – Galileo Galilei: laws of falling body
• 1643 – Evangelista Torricelli invents the mercury barometer
• 1662 – Robert Boyle: Boyle's law of ideal gas
• 1665 – Philosophical Transactions of the Royal Society first peer reviewed scientific journal published.
• 1665 – Robert Hooke: discovers the cell
• 1668 – Francesco Redi: disproved idea of spontaneous generation
• 1669 – Nicholas Steno: Proposes that fossils are organic remains embedded in layers of sediment, basis of stratigraphy
• 1669 – Jan Swammerdam: epigenesis in insects
• 1672 – Sir Isaac Newton: discovers that white light is a spectrum of a mixture of distinct coloured rays
• 1673 – Christiaan Huygens: first study of oscillating system and design of pendulum clocks
• 1675 – Leibniz, Newton: infinitesimal calculus
• 1675 – Anton van Leeuwenhoek: observes microorganisms by microscope
• 1676 – Ole Romer: first measurement of the speed of light
• 1687 – Sir Isaac Newton: classical mathematical description of the fundamental force of universal gravitation and the three physical laws of motion
1735 – Carl Linnaeus described a new system for classifying plants in Systema Naturae
1745 – Ewald Jürgen Georg von Kleist: first capacitor, the Leyden jar
1750 – Joseph Black: describes latent heat
1751 – Benjamin Franklin: Lightning is electrical
1755 – Immanuel Kant: Gaseous Hypothesis in Universal Natural History and Theory of Heaven
1761 – Mikhail Lomonosov: discovery of the atmosphere of Venus
1763 – Thomas Bayes: publishes the first version of Bayes' theorem, paving the way for Bayesian probability
1771 – Charles Messier: Publishes catalogue of astronomical objects (Messier Objects) now known to include galaxies, star clusters, and nebulae.
1778 – Antoine Lavoisier (and Joseph Priestley): discovery of oxygen leading to end of Phlogiston theory
1781 – William Herschel announces discovery of Uranus, expanding the known boundaries of the solar system for the first time in modern history
1785 – William Withering: publishes the first definitive account of the use of foxglove (digitalis) for treating dropsy
1787 – Jacques Charles: Charles's law of ideal gas
1789 – Antoine Lavoisier: law of conservation of mass, basis for chemistry, and the beginning of modern chemistry
1796 – Georges Cuvier: Establishes extinction as a fact
1796 – Edward Jenner: small pox historical accounting
1796 – Hanaoka Seishū: develops general anaesthesia
1800 – Alessandro Volta: discovers electrochemical series and invents the battery
1802 – Jean-Baptiste Lamarck: teleological evolution
1805 – John Dalton: Atomic Theory in (Chemistry)
1820 – Hans Christian Ørsted discovers that a current passed through a wire will deflect the needle of a compass, establishing a deep relationship between electricity and magnetism (electromagnetism).
1821 – Thomas Johann Seebeck is the first to observe a property of semiconductors
1824 – Carnot: described the Carnot cycle, the idealized heat engine
1827 – Georg Ohm: Ohm's law (Electricity)
1827 – Amedeo Avogadro: Avogadro's law (Gas law)
1828 – Friedrich Wöhler synthesized urea, destroying vitalism
1830 – Nikolai Lobachevsky created Non-Euclidean geometry
1831 – Michael Faraday discovers electromagnetic induction
1833 – Anselme Payen isolates first enzyme, diastase
1838 – Matthias Schleiden: all plants are made of cells
1838 – Friedrich Bessel: first successful measure of stellar parallax (to star 61 Cygni)
1842 – Christian Doppler: Doppler effect
1843 – James Prescott Joule: Law of Conservation of energy (First law of thermodynamics), also 1847 – Helmhotlz, Conservation of energy
1846 – Johann Gottfried Galle and Heinrich Louis d’Arrest: discovery of Neptune
1848 – Lord Kelvin: absolute zero
1858 – Rudolf Virchow: cells can only arise from pre-existing cells
1859 – Charles Darwin and Alfred Wallace: Theory of evolution by natural selection
1861 – Louis Pasteur: Germ theory
1861 – John Tyndall: Experiments in Radiant Energy that reinforced the Greenhouse Effect
1864 – James Clerk Maxwell: Theory of electromagnetism
1865 – Gregor Mendel: Mendel's laws of inheritance, basis for genetics
1865 – Rudolf Clausius: Definition of Entropy
1869 – Dmitri Mendeleev: Periodic table
1871 – Lord Rayleigh: Diffuse sky radiation (Rayleigh scattering) explains why sky appears blue
1873 – Johannes Diderik van der Waals: was one of the first to postulate an intermolecular force: the van der Waals force.
1873 – Frederick Guthrie discovers thermionic emission.
1873 – Willoughby Smith discovers photoconductivity.
1875 – William Crookes invented the Crookes tube and studied cathode rays
1876 – Josiah Willard Gibbs founded chemical thermodynamics, the phase rule
1877 – Ludwig Boltzmann: Statistical definition of entropy
1880 – Pierre Curie and Jacques Curie: Piezoelectricity
1884 – Jacobus Henricus van 't Hoff: discovered the laws of chemical dynamics and osmotic pressure in solutions (in his work "Etudes de dynamique chimique").
1887 – Albert A. Michelson and Edward W. Morley: lack of evidence for the aether
1888 – Friedrich Reinitzer discovers liquid crystals.
1892 – Dmitri Ivanovsky discovers for the first time a virus
1895 – Wilhelm Conrad Röntgen discovers x-rays
1896 – Henri Becquerel discovers radioactivity
1896 – Svante Arrhenius derives the basic principles of the greenhouse effect.
1897 – J.J. Thomson discovers the electron in cathode rays
1898 – Martinus Beijerinck: concluded a virus infectious—replicating in the host—and thus not a mere toxin and gave it the name "virus"
1898 – J.J. Thomson proposed the Plum pudding model of an atom
1905 – Albert Einstein: theory of special relativity—explanation of Brownian motion, and photoelectric effect
1906 – Walther Nernst: Third law of thermodynamics
1907 – Alfred Bertheim: Arsenphenamine, the first modern chemotherapeutic agent
1909 – Fritz Haber: Haber Process for industrial production of ammonia
1909 – Robert Andrews Millikan: conducts the oil drop experiment and determines the charge on an electron
1910 – Williamina Fleming: the first white dwarf, 40 Eridani B
1911 – Ernest Rutherford: Atomic nucleus
1911 – Heike Kamerlingh Onnes: Superconductivity
1912 – Alfred Wegener: Continental drift
1912 – Max von Laue: x-ray diffraction
1912 – Vesto Slipher: galactic redshifts
1912 – Henrietta Swan Leavitt: Cepheid variable period-luminosity relation
1913 – Henry Moseley: defined atomic number
1913 – Niels Bohr: Model of the atom
1915 – Albert Einstein: theory of general relativity – also David Hilbert
1915 – Karl Schwarzschild: discovery of the Schwarzschild radius leading to the identification of black holes
1918 – Emmy Noether: Noether's theorem – conditions under which the conservation laws are valid
1920 – Arthur Eddington: Stellar nucleosynthesis
1922 – Frederick Banting, Charles Best, James Collip, John Macleod: isolation and production of insulin to control diabetes
1924 – Wolfgang Pauli: quantum Pauli exclusion principle
1924 – Edwin Hubble: the discovery that the Milky Way is just one of many galaxies
1925 – Erwin Schrödinger: Schrödinger equation (Quantum mechanics)
1925 – Cecilia Payne-Gaposchkin: Discovery of the composition of the Sun and that Hydrogen is the most abundant element in the Universe

1927 – Werner Heisenberg: Uncertainty principle (Quantum mechanics)

1927 – Georges Lemaître: Theory of the Big Bang

1928 – Paul Dirac: Dirac equation (Quantum mechanics)

1929 – Edwin Hubble: Hubble's law of the expanding universe

1929 – Alexander Fleming: Penicillin, the first beta-lactam antibiotic

1929 – Lars Onsager's reciprocal relations, a potential fourth law of thermodynamics

1930 – Subrahmanyan Chandrasekhar discovers his eponymous limit of the maximum mass of a white dwarf star

1931 – Kurt Gödel: incompleteness theorems prove formal axiomatic systems are incomplete

1932 – James Chadwick: Discovery of the neutron

1932 – Karl Guthe Jansky discovers the first astronomical radio source, Sagittarius A

1932 – Ernest Walton and John Cockcroft: Nuclear fission by proton bombardment

1934 – Enrico Fermi: Nuclear fission by neutron irradiation

1934 – Clive McCay: Calorie restriction extends the maximum lifespan of another species

1938 – Otto Hahn, Lise Meitner and Fritz Strassmann: Nuclear fission of heavy nuclei

1938 – Isidor Rabi: Nuclear magnetic resonance

1943 – Oswald Avery proves that DNA is the genetic material of the chromosome

1945 – Howard Florey Mass production of penicillin

1947 – William Shockley, John Bardeen and Walter Brattain invent the first transistor

1948 – Claude Elwood Shannon: 'A mathematical theory of communication' a seminal paper in Information theory.

1948 – Richard Feynman, Julian Schwinger, Sin-Itiro Tomonaga and Freeman Dyson: Quantum electrodynamics

1951 – George Otto Gey propagates first cancer cell line, HeLa

1952 – Jonas Salk: developed and tested first polio vaccine

1952 – Stanley Miller: demonstrated that life could arise from primeval soup in the conditions present during early earth Miller–Urey experiment

1952 – Frederick Sanger: demonstrated that proteins are sequences of amino acids

1953 – James Watson, Francis Crick, Maurice Wilkins and Rosalind Franklin: helical structure of DNA, basis for molecular biology
- 1962 – Riccardo Giacconi and his team discover the first cosmic x-ray source, Scorpius X-1
- 1963 – Lawrence Morley, Fred Vine, and Drummond Matthews: Paleomagnetic stripes in ocean crust as evidence of plate tectonics (Vine-Matthews-Morley hypothesis).
- 1964 – Murray Gell-Mann and George Zweig: postulates quarks leading to the standard model
- 1964 – Arno Penzias and Robert Woodrow Wilson: detection of CMBR providing experimental evidence for the Big Bang
- 1965 – Leonard Hayflick: normal cells divide only a certain number of times: the Hayflick limit
- 1967 – Jocelyn Bell Burnell and Antony Hewish discover first pulsar
- 1967 – Vela nuclear test detection satellites discover the first gamma-ray burst
- 1971 – Place cells in the brain are discovered by John O'Keefe
- 1974 – Russell Alan Hulse and Joseph Hooton Taylor, Jr. discover indirect evidence for gravitational wave radiation in the Hulse–Taylor binary
- 1977 – Frederick Sanger sequences the first DNA genome of an organism using Sanger sequencing
- 1980 – Klaus von Klitzing discovered the Quantum Hall Effect.
- 1982 – Donald C. Backer et al. discover the first millisecond pulsar
- 1983 – Kary Mullis invents the polymerase chain reaction, a key discovery in molecular biology.
- 1986 – Karl Müller and Johannes Bednorz: Discovery of High-temperature superconductivity.
- 1988 – Bart van Wees [nl] and colleagues at TU Delft and Philips Research discovered the quantized conductance in a two-dimensional electron gas.
- 1992 – Aleksander Wolszczan and Dale Frail observe the first pulsar planets (this was the first confirmed discovery of planets outside the Solar System)
- 1994 – Andrew Wiles proves Fermat's Last Theorem
- 1995 – Michel Mayor and Didier Queloz definitively observe the first extrasolar planet around a main sequence star
- 1995 – Eric Cornell, Carl Wieman and Wolfgang Ketterle attained the first Bose-Einstein Condensate with atomic gases, so called fifth state of matter at an extremely low temperature.
- 1996 – Roslin Institute: Dolly the sheep was cloned.
- 1997 – CDF and DØ experiments at Fermilab: Top quark.
- 2000 – The Tau neutrino is discovered by the DONUT collaboration
- 2001 – The first draft of the Human Genome Project is published.
• 2003 – Grigori Perelman presents proof of the Poincaré Conjecture.
• 2004 – Andre Geim and Konstantin Novoselov isolated graphene, a monolayer of carbon atoms, and studied its quantum electrical properties.
• 2005 – Grid cells in the brain are discovered by Edvard Moser and May-Britt Moser.
• 2010 – The first Self-Replicating, Synthetic Bacterial Cells are Constructed.
• 2010 – The Neanderthal Genome Project presented preliminary genetic evidence that interbreeding did likely take place and that a small but significant portion of Neanderthal admixture is present in modern non-African populations.
• 2012 – Higgs boson is discovered at CERN (confirmed to 99.999% certainty)
• 2012 – Photonic molecules are discovered at MIT
• 2014 – Exotic hadrons are discovered at the LHCb
• 2015 – Traces of liquid water discovered on Mars (Since refuted in NASA report from 2017!)
• 2016 – The LIGO team detected gravitational waves from a black hole merger.
• 2017 – Gravitational wave signal GW170817 was observed by the LIGO/Virgo collaboration. This was the first instance of a gravitational wave event that was observed to have a simultaneous electromagnetic signal when space telescopes like Hubble observed lights coming from the event, thereby marking a significant breakthrough for multi-messenger astronomy.
• 2018 - The first genetically engineered babies (Lulu and Nana)
• 2019 – The first ever image of a black hole was captured, using eight different telescopes taking simultaneous pictures, timed with extremely precise atomic clocks.

Timeline of cosmological theories

• ca. 16th century BCE — Mesopotamian cosmology has a flat, circular Earth enclosed in a cosmic ocean.
• ca. 12th century BCE — The Rigveda has some cosmological hymns, particularly in the late book 10, notably the Nasadiya Sukta which describes the origin of the universe, originating from the monistic Hiranyagarbha or "Golden Egg".
• 6th century BCE — The Babylonian world map shows the Earth surrounded by the cosmic ocean, with seven islands arranged around it so as to form a seven-pointed star. Contemporary Biblical cosmology reflects the same view of a flat, circular Earth swimming on water and overarched by the solid vault of the firmament to which are fastened the stars.
• 4th century BCE — Aristotle proposes an Earth-centered universe in which the Earth is stationary and the cosmos (or universe) is finite in extent but infinite in time
- **4th century BCE** — De Mundo - Five elements, situated in spheres in five regions, the less being in each case surrounded by the greater — namely, earth surrounded by water, water by air, air by fire, and fire by ether — make up the whole Universe.

- **3rd century BCE** — Aristarchus of Samos proposes a Sun-centered universe

- **3rd century BCE** — Archimedes in his essay The Sand Reckoner, estimates the diameter of the cosmos to be the equivalent in stadia of what we call two light years

- **2nd century BCE** — Seleucus of Seleucia elaborates on Aristarchus' heliocentric universe, using the phenomenon of tides to explain heliocentrism

- **2nd century CE** — Ptolemy proposes an Earth-centered universe, with the Sun, Moon, and visible planets revolving around the Earth

- **5th-11th centuries** — Several astronomers propose a Sun-centered universe, including Aryabhata, Albumasar and Al-Sijzi

- **6th century** — John Philoponus proposes a universe that is finite in time and argues against the ancient Greek notion of an infinite universe

  Revealed in the 6th century, the Qur'an mentions Chapter 21: Verse 30 - "Have those who disbelieved not considered that the heavens and the earth were a joined entity, and We separated them ..."

- **ca. 8th century** — Puranic Hindu cosmology, in which the Universe goes through repeated cycles of creation, destruction and rebirth, with each cycle lasting 4.32 billion years.

- **9th-12th centuries** — Al-Kindi (Alkindus), Saadia Gaon (Saadia ben Joseph) and Al-Ghazali (Algazel) support a universe that has a finite past and develop two logical arguments against the notion of an infinite past, one of which is later adopted by Immanuel Kant

- **964** — Abd al-Rahman al-Sufi (Azophi), a Persian astronomer, makes the first recorded observations of the Andromeda Galaxy and the Large Magellanic Cloud, the first galaxies other than the Milky Way to be observed from Earth, in his Book of Fixed Stars

- **12th century** — Fakhr al-Din al-Razi discusses Islamic cosmology, rejects Aristotle's idea of an Earth-centered universe, and, in the context of his commentary on the Qur'anic verse, "All praise belongs to God, Lord of the Worlds," proposes that the universe has more than "a thousand thousand worlds beyond this world such that each one of those worlds be bigger and more massive than this world as well as having the like of what this world has." He argued that there exists an infinite outer space beyond the known world, and that there could be an infinite number of universes.

- **13th century** — Naṣīr al-Dīn al-Tūsī provides the first empirical evidence for the Earth's rotation on its axis

- **15th century** — Ali Qushji provides empirical evidence for the Earth's rotation on its axis and rejects the stationary Earth theories of Aristotle and Ptolemy
• **15th-16th centuries** — Nilakantha Somayaji and Tycho Brahe propose a universe in which the planets orbit the Sun and the Sun orbits the Earth, known as the Tychonic system

• **1543** — Nicolaus Copernicus publishes his heliocentric universe in his *De revolutionibus orbium coelestium*

• **1576** — Thomas Digges modifies the Copernican system by removing its outer edge and replacing the edge with a star-filled unbounded space

• **1584** — Giordano Bruno proposes a non-hierarchical cosmology, wherein the Copernican Solar System is not the center of the universe, but rather, a relatively insignificant star system, amongst an infinite multitude of others

• **1610** — Johannes Kepler uses the dark night sky to argue for a finite universe

• **1687** — Sir Isaac Newton's laws describe large-scale motion throughout the universe

• **1720** — Edmund Halley puts forth an early form of Olbers' paradox

• **1729** - James Bradley discovers the aberration of light, due to the Earth's motion around the Sun.

• **1744** — Jean-Philippe de Cheseaux puts forth an early form of Olbers' paradox

• **1755** — Immanuel Kant asserts that the nebulae are really galaxies separate from, independent of, and outside the Milky Way Galaxy; he calls them island universes.

• **1785** — William Herschel proposes the theory that our Sun is at or near the center of the galaxy.

• **1791** — Erasmus Darwin pens the first description of a cyclical expanding and contracting universe in his poem *The Economy of Vegetation*

• **1826** — Heinrich Wilhelm Olbers puts forth Olbers' paradox

• **1837** - Following over 100 years of unsuccessful attempts, Friedrich Bessel, Thomas Henderson and Otto Struve measure the parallax of a few nearby stars; this is the first measurement of any distances outside the Solar System.

• **1848** — Edgar Allan Poe offers first correct solution to Olbers' paradox in *Eureka: A Prose Poem*, an essay that also suggests the expansion and collapse of the universe

• **1860s** - William Huggins develops astronomical spectroscopy; he shows that the Orion nebula is mostly made of gas, while the Andromeda nebula (later called Andromeda Galaxy) is probably dominated by stars.

• **1905** — Albert Einstein publishes the Special Theory of Relativity, positing that space and time are not separate continua

• **1912** - Henrietta Leavitt discovers the period-luminosity law for Cepheid variable stars, which becomes a crucial step in measuring distances to other galaxies.

• **1915** — Albert Einstein publishes the General Theory of Relativity, showing that an energy density warps spacetime
• 1917 — Willem de Sitter derives an isotropic static cosmology with a cosmological constant, as well as an empty expanding cosmology with a cosmological constant, termed a de Sitter universe.

• 1920 — The Shapley-Curtis Debate, on the distances to spiral nebulae, takes place at the Smithsonian.

• 1921 — The National Research Council (NRC) published the official transcript of the Shapley-Curtis Debate.

• 1922 — Vesto Slipher summarizes his findings on the spiral nebulae's systematic redshifts.

• 1922 — Alexander Friedmann finds a solution to the Einstein field equations which suggests a general expansion of space.

• 1923 — Edwin Hubble measures distances to a few nearby spiral nebulae (galaxies), the Andromeda Galaxy (M31), Triangulum Galaxy (M33), and NGC 6822. The distances place them far outside our Milky Way, and implies that fainter galaxies are much more distant, and the universe is composed of many thousands of galaxies.

• 1927 — Georges Lemaître discusses the creation event of an expanding universe governed by the Einstein field equations. From its solutions to the Einstein equations, he predicts the distance-redshift relation.

• 1928 — Howard P. Robertson briefly mentions that Vesto Slipher's redshift measurements combined with brightness measurements of the same galaxies indicate a redshift-distance relation.

• 1929 — Edwin Hubble demonstrates the linear redshift-distance relation and thus shows the expansion of the universe.

• 1933 — Edward Milne names and formalizes the cosmological principle.

• 1933 — Fritz Zwicky shows that the Coma cluster of galaxies contains large amounts of dark matter. This result agrees with modern measurements, but is generally ignored until the 1970s.

• 1934 — Georges Lemaître interprets the cosmological constant as due to a vacuum energy with an unusual perfect fluid equation of state.

• 1938 — Paul Dirac suggests the large numbers hypothesis, that the gravitational constant may be small because it is decreasing slowly with time.

• 1948 — Ralph Alpher, Hans Bethe ("in absentia"), and George Gamow examine element synthesis in a rapidly expanding and cooling universe, and suggest that the elements were produced by rapid neutron capture.

• 1948 — Hermann Bondi, Thomas Gold, and Fred Hoyle propose steady state cosmologies based on the perfect cosmological principle.

• 1948 — George Gamow predicts the existence of the cosmic microwave background radiation by considering the behavior of primordial radiation in an expanding universe.

• 1950 — Fred Hoyle coins the term "Big Bang", saying that it was not derisive; it was just a striking image meant to highlight the difference between that and the Steady-State model.
1961 — Robert Dicke argues that carbon-based life can only arise when the gravitational force is small, because this is when burning stars exist; first use of the weak anthropic principle

1963 — Maarten Schmidt discovers the first quasar; these soon provide a probe of the universe back to substantial redshifts.

1965 — Hannes Alfvén proposes the now-discounted concept of ambiplasma to explain baryon asymmetry and supports the idea of an infinite universe.

1965 — Martin Rees and Dennis Sciama analyze quasar source count data and discover that the quasar density increases with redshift.

1965 — Arno Penzias and Robert Wilson, astronomers at Bell Labs discover the 2.7 K microwave background radiation, which earns them the 1978 Nobel Prize in Physics. Robert Dicke, James Peebles, Peter Roll and David Todd Wilkinson interpret it as a relic from the big bang.

1966 — Stephen Hawking and George Ellis show that any plausible general relativistic cosmology is singular

1966 — James Peebles shows that the hot Big Bang predicts the correct helium abundance

1967 — Andrei Sakharov presents the requirements for baryogenesis, a baryon-antibaryon asymmetry in the universe

1967 — John Bahcall, Wal Sargent, and Maarten Schmidt measure the fine-structure splitting of spectral lines in 3C191 and thereby show that the fine-structure constant does not vary significantly with time

1967 — Robert Wagner, William Fowler, and Fred Hoyle show that the hot Big Bang predicts the correct deuterium and lithium abundances

1968 — Brandon Carter speculates that perhaps the fundamental constants of nature must lie within a restricted range to allow the emergence of life; first use of the strong anthropic principle

1969 — Charles Misner formally presents the Big Bang horizon problem

1969 — Robert Dicke formally presents the Big Bang flatness problem

1970 — Vera Rubin and Kent Ford measure spiral galaxy rotation curves at large radii, showing evidence for substantial amounts of dark matter.

1973 — Edward Tryon proposes that the universe may be a large scale quantum mechanical vacuum fluctuation where positive mass-energy is balanced by negative gravitational potential energy

1976 — Alex Shlyakhter uses samarium ratios from the Oklo prehistoric natural nuclear fission reactor in Gabon to show that some laws of physics have remained unchanged for over two billion years

1977 — Gary Steigman, David Schramm, and James Gunn examine the relation between the primordial helium abundance and number of neutrinos and claim that at most five lepton families can exist.

1980 — Alan Guth and Alexei Starobinsky independently propose the inflationary Big Bang universe as a possible solution to the horizon and flatness problems.
- **1981** — Viacheslav Mukhanov and G. Chibisov propose that quantum fluctuations could lead to large scale structure in an inflationary universe.

- **1982** — The first CfA galaxy redshift survey is completed.

- **1982** — Several groups including James Peebles, J. Richard Bond and George Blumenthal propose that the universe is dominated by cold dark matter.

- **1983 - 1987** — The first large computer simulations of cosmic structure formation are run by Davis, Efstathiou, Frenk and White. The results show that cold dark matter produces a reasonable match to observations, but hot dark matter does not.

- **1988** — The CfA2 Great Wall is discovered in the CfA2 redshift survey.

- **1988** — Measurements of galaxy large-scale flows provide evidence for the Great Attractor.

- **1990** — Preliminary results from NASA's COBE mission confirm the cosmic microwave background radiation has a blackbody spectrum to an astonishing one part in 105 precision, thus eliminating the possibility of an integrated starlight model proposed for the background by steady state enthusiasts.

- **1992** — Further COBE measurements discover the very small anisotropy of the cosmic microwave background, providing a "baby picture" of the seeds of large-scale structure when the universe was around 1/1100th of its present size and 380,000 years old.

- **1996** — The first Hubble Deep Field is released, providing a clear view of very distant galaxies when the universe was around one-third of its present age.

- **1998** — Controversial evidence for the fine structure constant varying over the lifetime of the universe is first published.

- **1998** — The Supernova Cosmology Project and High-Z Supernova Search Team discover cosmic acceleration based on distances to Type Ia supernovae, providing the first direct evidence for a non-zero cosmological constant.

- **1999** — Measurements of the cosmic microwave background radiation with finer resolution than COBE, (most notably by the BOOMERanG experiment see Mauskopf et al., 1999, Melchiorri et al., 1999, de Bernardis et al. 2000) provide evidence for oscillations (the first acoustic peak) in the anisotropy angular spectrum, as expected in the standard model of cosmological structure formation. The angular position of this peak indicates that the geometry of the universe is close to flat.

- **2001** — The 2dF Galaxy Redshift Survey (2dF) by an Australian/British team gave strong evidence that the matter density is near 25% of critical density. Together with the CMB results for a flat universe, this provides independent evidence for a cosmological constant or similar dark energy.

- **2002** — The Cosmic Background Imager (CBI) in Chile obtained images of the cosmic microwave background radiation with the highest angular resolution of 4 arc minutes. It also obtained the anisotropy spectrum at high-resolution not covered before up to l ~ 3000. It found a slight excess in power at high-resolution (l > 2500) not yet completely explained, the so-called "CBI-excess".
• **2003** — NASA’s Wilkinson Microwave Anisotropy Probe (WMAP) obtained full-sky detailed pictures of the cosmic microwave background radiation. The images can be interpreted to indicate that the universe is 13.7 billion years old (within one percent error), and are very consistent with the Lambda-CDM model and the density fluctuations predicted by inflation.

• **2003** — The Sloan Great Wall is discovered.

• **2004** — The Degree Angular Scale Interferometer (DASI) first obtained the E-mode polarization spectrum of the cosmic microwave background radiation.

• **2005** — The Sloan Digital Sky Survey (SDSS) and 2dF redshift surveys both detected the baryon acoustic oscillation feature in the galaxy distribution, a key prediction of cold dark matter models.

• **2006** — The long-awaited three-year WMAP results are released, confirming previous analysis, correcting several points, and including polarization data.

• **2006–2011** — Improved measurements from WMAP, new supernova surveys ESSENCE and SNLS, and baryon acoustic oscillations from SDSS and WiggleZ, continue to be consistent with the standard Lambda-CDM model.

• **2014** — On March 17, 2014, astrophysicists of the BICEP2 collaboration announced the detection of inflationary gravitational waves in the B-mode power spectrum, which if confirmed, would provide clear experimental evidence for the theory of inflation. However, on June 19, 2014, lowered confidence in confirming the cosmic inflation findings was reported.

• **2016** — On February 11, 2016, LIGO Scientific Collaboration and Virgo Collaboration announced that gravitational waves were directly detected by two LIGO detectors. The waveform matched the prediction of General relativity for a gravitational wave emanating from the inward spiral and merger of a pair of black holes of around 36 and 29 solar masses and the subsequent “ringdown” of the single resulting black hole. The second detection verified that GW150914 is not a fluke, thus opens entire new branch in astrophysics, gravitational-wave astronomy.

**Timeline of paleontology**

• 6th century B.C. — The pre-Socratic Greek philosopher Xenophanes of Colophon argues that fossils of marine organisms show that dry land was once under water.

• 1027 — The Persian naturalist, Avicenna, explains the stoniness of fossils in The Book of Healing by proposing the theory of petrifying fluids (succus lapidificatus).
• 1031-1095 — The Chinese naturalist, Shen Kuo, uses evidence of marine fossils found in the Taihang Mountains to infer geological processes caused shifting of seashores over time, and uses petrified bamboos found underground in Yan'an, to argue for gradual climate change.

• 1320-1390 — Avicenna's theory of petrifying fluids (succus lapidificatus) was elaborated on by Albert of Saxony.

• c. 1500 — Leonardo da Vinci uses ichnofossils to complement his hypothesis concerning the biogenic nature of body fossils.

• 1665 — In his book Micrographia Robert Hooke compares petrified wood to wood, concludes that petrified wood formed from wood soaked in mineral-rich water, and argues that fossils like Ammonite shells were produced the same way, sparking debate over the organic origin of fossils and the possibility of extinction.

• 1669 — Nicholas Steno writes that some kinds of rock formed from layers of sediment deposited in water, and that fossils were organic remains buried in the process.

• 1770 — The fossilised bones of a huge animal are found in a quarry near Maastricht in the Netherlands. In 1808 Georges Cuvier identified it as an extinct marine reptile and in 1822 William Conybeare named it Mosasaurus.

• 1789 — The skeleton of a large animal is unearthed in Argentina. In 1796 Cuvier reports that it had an affinity to modern tree sloths and names it Megatherium.

• 1796 — Cuvier presents a paper on living and fossil elephants that shows that mammoths were a different species from any living elephant. He argues that this proved the reality of extinction, which he attributes to a geological catastrophe.

• 1800 — Cuvier writes that a drawing of a fossil found in Bavaria shows a flying reptile; in 1809 he names it Pterodactyl.

• 1808 — Cuvier and Alexandre Brongniart publish preliminary results of their survey of the geology of the Paris Basin that uses the fossils found in different strata to reconstruct the geologic history of the region.

• 1811 — Mary Anning and her brother Joseph discover the fossilised remains of an ichthyosaur at Lyme Regis.

• 1815 — William Smith published The Map that Changed the World, the first geologic map of England, Wales, and southern Scotland, using fossils to correlate rock strata.

• 1821 — William Buckland analyzes Kirkdale Cave in Yorkshire, containing the bones of lions, elephants and rhinoceros, and concludes it was a prehistoric hyena den.

• 1821-1822 — Mary Anning discovers the world's first Plesiosaur skeleton at Lyme Regis.

• 1822 — Mary Ann Mantell and Gideon Mantell discover fossil teeth of the dinosaur Iguanodon.

• 1822 — The editor of the French journal Journal de Phisique, Henri Marie Ducrotay de Blainville, invents the word "paleontologie" for the reconstruction of ancient animals and plants from fossils.
• 1823 — Buckland finds a human skeleton with mammoth remains at Paviland Cave on the Gower Peninsula, but at the time it is not accepted that this showed they coexisted.

• 1824 — Buckland finds lower jaw of the carnivorous dinosaur Megalosaurus.

• 1829 — Buckland publishes paper on work he and Mary Anning had done identifying and analyzing fossilized feces found at Lyme Regis and elsewhere. Buckland coins the term coprolite for them, and uses them to analyze ancient food chains.

• 1830 — The Cuvier–Geoffroy debate in Paris on the determination of animal structure

• 1831 — Mantell publishes an influential paper entitled "The Age of Reptiles" summarizing evidence of an extended period during which large reptiles had been the dominant animals.

• 1832 — Mantell finds partial skeleton of the dinosaur Hylaeosaurus.

• 1836 — Edward Hitchcock describes footprints (Eubrontes and Otozoum) of giant birds from Jurassic formations in Connecticut. Later they would be recognized as dinosaur tracks.

• 1841 — Anatomist Richard Owen creates a new order of reptiles, dinosauria, for animals: Iguanodon, Megalosaurus, and Hylaeosaurus, found by Mantell and Buckland.

• 1841 — The first global geologic timescale is defined by John Phillips based on the type of fossils found in different rock layers. He coins the term Mesozoic for what Mantell had called the age of reptiles.

• 1856 — Fossils are found in the Neander Valley in Germany that Johann Carl Fuhlrott and Hermann Schaaffhausen recognize as a human different from modern people. A few years later William King names Homo neanderthalensis.

• 1858 — The first dinosaur skeleton found in the United States, Hadrosaurus, is excavated and described by Joseph Leidy.

• 1859 — Charles Darwin publishes On The Origin of Species.

• 1861 — The first Archaeopteryx, skeleton is found in Bavaria, Germany, and recognized as a transitional form between reptiles and birds.

• 1869 — Joseph Lockyer starts the scientific journal Nature

• 1871 — Othniel Charles Marsh discovers the first American pterosaur fossils.

• 1874-77 — Marsh finds a series of Equid fossils in the American West that shed light on the evolution of the horse.

• 1877 — The first Diplodocus skeleton is found near Cañon City, Colorado.

• 1891 — Eugene Dubois discovers fossils of Java Man (Homo erectus) in Indonesia.

• 1901 — Petroleum geologist W.W. Orcutt recovers first fossils from the La Brea Tar Pits in Southern California, a rich source of ice age mammal remains.

• 1905 — Tyrannosaurus rex is described and named by Henry Fairfield Osborn.
• 1909 — Cambrian fossils in the Burgess Shale are discovered by Charles Walcott.
• 1912 — Continental Drift is proposed by Alfred Wegener, leading to plate tectonics, which explained many patterns of ancient biogeography revealed by the fossil record.
• 1912 — Charles Dawson announces discovery of Piltdown Man in England, a hoax that would confuse paleoanthropology until the fossils were revealed as forgeries in 1953.
• 1912-15 — Spinosaurus is found in North Africa and is speculated to be the largest terrestrial predator that ever lived.
• 1920 — Andrew Douglass proposes dendrochronology (tree-ring dating).
• 1924 — Raymond Dart examines fossils of Taung Child, found by quarrymen in South Africa, and names Australopithecus africanus.
• 1944 — The publication of Tempo and Mode in Evolution by George Gaylord Simpson integrates paleontology into the modern evolutionary synthesis.
• 1946 — Reginald Sprigg discovers fossils of the Ediacaran biota in Australia. In the 1960s Martin Glaessner would show that they were pre-Cambrian.
• 1947 — Willard Libby introduces carbon-14 dating.
• 1953 — Stanley A. Tyler discovers microfossils in the gunflint chert formation of cyanobacteria that created pre-Cambrian stromatolites approximately 2 billion years ago.
• 1967 — Paul S. Martin proposes the overkill hypothesis, that the extinction of the Pleistocene megafauna in North America resulted from over hunting by Native Americans.
• 1972 — Niles Eldredge and Stephen Jay Gould propose punctuated equilibrium, claiming that the evolutionary history of most species involves long intervals of stasis between relatively short periods of rapid change.
• 1974 — Donald Johanson and Tom Gray discover a 3.5 million-year-old female hominid fossil that is 40% complete and name it "Lucy".
• 1980 — Luis Alvarez, Walter Alvarez, Frank Asaro, and Helen Michel propose the Alvarez hypothesis, that a comet or asteroid struck the Earth 66 million years ago causing the Cretaceous–Paleogene extinction event, including the extinction of the non-avian dinosaurs, and enriching the iridium in the K–T boundary.
• 1982 — Jack Sepkoski and David M. Raup publish a statistical analysis of the fossil record of marine invertebrates that shows a pattern (possibly cyclical) of repeated mass extinctions.
• 1984 — Hou Xianguang discovers the Maotianshan Shales Cambrian fossil site in the Yunnan province of China.
• 1993 — Johannes G.M. Thewissen and Sayed Taseer Hussain discover fossils of the amphibious whale ancestor Ambulocetus in Pakistan.
1996 — Li Yumin discovers a fossil of the theropod dinosaur Sinosauropteryx showing evidence of feathers in the Liaoning province of China.

2004 — Tiktaalik, a transitional form between lobe-finned fish and tetrapods is discovered in Canada by Ted Daeschler, Neil H. Shubin, and Farish A. Jenkins Jr..

2009 — Fossils of Titanoboa, a giant snake, are unearthed in the coal mines of Cerrejón in La Guajira, Colombia, suggesting paleocene equatorial temperatures were higher than today."

2016 — Tail fossils of a baby species of Coelurosaur, fully preserved in amber including soft tissue, are found in Myanmar by Lida Xing.

Timeline of biotechnology

- 7000 BCE – Chinese discover fermentation through beer making.
- 6000 BCE – Yogurt and cheese made with lactic acid-producing bacteria by various people.
- 4000 BCE – Egyptians bake leavened bread using yeast.
- 500 BCE – Moldy soybean curds used as an antibiotic.
- 100 CE – Chinese use chrysanthemum as a natural insecticide.
- 1663 – First recorded description of living cells by Robert Hooke.
- 1677 – Antonie van Leeuwenhoek discovers and describes bacteria and protozoa.
- 1798 – Edward Jenner uses first viral vaccine to inoculate a child from smallpox.
- 1802 – The first recorded use of the word biology.
- 1824 – Henri Dutrochet discovers that tissues are composed of living cells.
- 1838 – Protein discovered, named and recorded by Gerardus Johannes Mulder and Jöns Jacob Berzelius.
- 1862 – Louis Pasteur discovers the bacterial origin of fermentation.
- 1863 – Gregor Mendel discovers the laws of inheritance.
- 1864 – Antonin Prandtl invents first centrifuge to separate cream from milk.
- 1869 – Friedrich Miescher identifies DNA in the sperm of a trout.
- 1871 – Ernst Hoppe-Seyler discovers invertase, which is still used for making artificial sweeteners.
- 1877 – Robert Koch develops a technique for staining bacteria for identification.
- 1878 – Walther Flemming discovers chromatin leading to the discovery of chromosomes.
- 1881 – Louis Pasteur develops vaccines against bacteria that cause cholera and anthrax in chickens.
1885 – Louis Pasteur and Emile Roux develop the first rabies vaccine and use it on Joseph Meister.

1919 – Károly Ereky, a Hungarian agricultural engineer, first uses the word biotechnology.

1928 – Alexander Fleming notices that a certain mould could stop the duplication of bacteria, leading to the first antibiotic: penicillin.

1933 – Hybrid corn is commercialized.

1942 – Penicillin is mass-produced in microbes for the first time.

1950 – The first synthetic antibiotic is created.

1951 – Artificial insemination of livestock is accomplished using frozen semen.


1953 – James D. Watson and Francis Crick describe the structure of DNA.

1958 – The term bionics is coined by Jack E. Steele.

1964 – The first commercial myoelectric arm is developed by the Central Prosthetic Research Institute of the USSR, and distributed by the Hangar Limb Factory of the UK.

1972 – The DNA composition of chimpanzees and gorillas is discovered to be 99% similar to that of humans.

1973 – Stanley Norman Cohen and Herbert Boyer perform the first successful recombinant DNA experiment, using bacterial genes.

1974 – Scientist invent the first biocement for industrial applications.

1975 – Method for producing monoclonal antibodies developed by Köhler and César Milstein.

1978 – North Carolina scientists Clyde Hutchison and Marshall Edgell show it is possible to introduce specific mutations at specific sites in a DNA molecule.

1980 – The U.S. patent for gene cloning is awarded to Cohen and Boyer.

1982 – Humulin, Genentech's human insulin drug produced by genetically engineered bacteria for the treatment of diabetes, is the first biotech drug to be approved by the Food and Drug Administration.

1983 – The Polymerase Chain Reaction (PCR) technique is conceived.

1990 – First federally approved gene therapy treatment is performed successfully on a young girl who suffered from an immune disorder.

1994 – The United States Food and Drug Administration approves the first GM food: the "Flavr Savr" tomato.

1997 – British scientists, led by Ian Wilmut from the Roslin Institute, report cloning Dolly the sheep using DNA from two adult sheep cells.

1999 – Discovery of the gene responsible for developing cystic fibrosis.
• 2000 – Completion of a "rough draft" of the human genome in the Human Genome Project.
• 2001 – Celera Genomics and the Human Genome Project create a draft of the human genome sequence. It is published by Science and Nature Magazine.
• 2002 – Rice becomes the first crop to have its genome decoded.
• 2003 – The Human Genome Project is completed, providing information on the locations and sequence of human genes on all 46 chromosomes.
• 2008 – Japanese astronomers launch the first Medical Experiment Module called "Kibo", to be used on the International Space Station.
• 2009 – Cedars-Sinai Heart Institute uses modified SAN heart genes to create the first viral pacemaker in guinea pigs, now known as iSANs.
• 2012 – Thirty-one-year-old Zac Vawter successfully uses a nervous system-controlled bionic leg to climb the Chicago Willis Tower.

Timeline of British botany

• 1538: First British flora "Libellus de Herbaria" by William Turner's published.

"A new Herball, wherin are conteined
the names of Herbes ... with the properties degrees
and naturall places of the same, gathered and made
by Wylliam Turner, Physicion unto the Duke of Somertesses
Grace" is the complete name of his great work of botany.
The first part was published in London, printed by
Steven Myerdman in 1551), the second was published
in 1562 and the third in 1568, both in exile in
Germany, by Arnold Birckman of Cologne.
These volumes were the first clear and systematic
investigation of the plants of England. The work had admirable wood engravings
(basically copied from Leonhart Fuchs'
work De historia Stirpium, 1542)
along with the detailed observations
obtained by Turner in his field studies. At the
same time, Turner included a list of the “uses and virtues” of plants and in the preface admits that he may be accused of disclosing to the general public what should have been reserved for a professional audience. Thus for the first time a flora of England in the vernacular was available, so that most English plants could easily be identified.

- **1597**: John Gerard's Herball, or general historie of plants was published in London.
- **1636**: Enlarged edition of the Herball by Thomas Johnson.
- **1644**: Thomas Johnson (botanist) and author of Mercurius botanicus died in Hampshire.
- **1650**: William How's Phytologia Britannica was published in London.
- **1900s**: Frederick Hamilton Davey's Flora of Cornwall was published in Penzance.
- **1951**: Diapensia lapponica, a new species for Britain, is found at Sgurr an Utha, Inverness-shire by C. F. Tebbutt.
- **1965**: The Concise British Flora by William Keble Martin was published in May.
- **1986**: Red Helleborine Cephalanthera rubra is found at Hawkley Warren, Hampshire by K. Turner and Ralph Hollins.

**Timeline of scientific experiments**

- **430 BC**: Empedocles proves that air is a material substance by submerging a clepsydra into the ocean.
- **240 BC**: Archimedes devised a principle which he later used to solve the riddle of the suspect crown.
- **230 BC**: Eratosthenes measures the Earth's circumference and diameter.
- **905**: Jābir ibn Hayyān (Geber) introduces the experimental method and controlled experiment in chemistry.
- **905**: Muhammad ibn Zakariya Rāzi (Rhazes) introduces controlled experiment into the field of medicine and carried out the first medical experiment in order to find the most hygienic place to build a hospital.
- **1020**: Avicenna (Ibn Sina) introduces experimentation and quantification into the study of medicine and physiology, including the introduction of experimental medicine and clinical trials, in The Canon of Medicine.
- **1021**: Ibn al-Haytham (Alhacen) pioneers the experimental scientific method and experimental physics in his Book of Optics, where he devises the first scientific experiments on optics, including the first use of
the camera obscura to prove that light travels in straight lines and the first experimental proof that visual perception is caused by light rays travelling to the eyes, which also marks the beginning of experimental psychology and psychophysics.

- 1030 – Abū Rayhān al-Bīrūnī conducts the first elaborate experiments related to astronomical phenomena and introduces the experimental method into mechanics.
- 1121 – Al-Khazini makes extensive use of the experimental method to prove his theories on mechanics in The Book of the Balance of Wisdom.
- Ibn Zuhr (Avenzoar) is the first physician to carry out human postmortem dissections and autopsies. He proves that the skin disease scabies is caused by a parasite, a discovery which upsets the Hippocratic and Galenic theory of humorism.
- 1200 – Abd-el-latif observes and examines a large number of skeletons, and he discovered that Galen was incorrect regarding the formation of the bones of the lower jaw and sacrum.
- 1242 – Ibn al-Nafis carries out autopsies which leads him to the discovery of pulmonary circulation and the circulatory system.
- Kamāl al-Dīn al-Fārisī provides the first correct explanation of the rainbow phenomenon and uses the experimental method to prove his theory.
- Albertus Magnus documents that nitric acid can dissolve silver and the resulting silver nitrate solution will blacken skin.
- 1572 – Tycho Brahe observes the 1572 supernova, evidence against the Aristotelian notion of an immutable heavenly sphere.
- 1609 – Galileo Galilei observes moons of Jupiter in support of the heliocentric model.
- 1638 – Galileo Galilei uses rolling balls to disprove the Aristotelian theory of motion.
- 1665 – Robert Hooke, using a microscope, observes cells.
- 1672 – Isaac Newton publishes the results of his Prism experiments, demonstrating the existence in white light of a mixture of distinct coloured rays.
- 1676 – Ole Rømer measures the speed of light for the first time.
- 1687 – Isaac Newton publishes the thought experiment Newton's cannonball, hypothesizes that the force of gravity is universal and is the key force for planetary motion.
- 1747 – James Lind: Conducts one of the earliest European clinical trials, showing that scurvy was cured by consuming fresh oranges and lemons, but not other tested acids or drinks.
- 1774 – Charles Mason: Conducts an experiment near the Scottish mountain of Schiehallion that attempts to measure the mean density of the Earth for the first time. Known as the Schiehallion experiment.
- 1796 – Edward Jenner: tests the first vaccine.
- 1798 – Henry Cavendish: Torsion bar experiment to measure Newton's gravitational constant.
1801 – Thomas Young: double-slit experiment demonstrates the wave nature of light.

1820 – Hans Christian Ørsted discovers the connection between electricity and magnetism.

1843 – James Prescott Joule measures the equivalence between mechanical work and heat, resulting in the law of conservation of energy.

1845 – Christian Doppler demonstrates the Doppler shift.

1851 – Léon Foucault uses Foucault pendulum to demonstrate the rotation of the Earth.

1859 – Charles Darwin publishes The Origin of Species showing that evolution occurs by natural selection.

1861 – Louis Pasteur disproves the theory of spontaneous generation.

1863 – Gregor Mendel's pea plant experiments (Mendel's laws of inheritance).

1887 – Heinrich Hertz discovers the photoelectric effect.

1887 – Michelson and Morley: Michelson–Morley experiment, showing that the speed of light is invariant.

1896 – Henri Becquerel discovers radioactivity.

1897 – J. J. Thomson discovers the electron.

1909 – Robert Millikan: oil-drop experiment which suggests that electric charge occurs as quanta (the electron).

1911 – Ernest Rutherford's gold foil experiment determines that atoms are mostly empty space, and that the core of each atom, which he named the atomic nucleus, is dense and positively charged.

1911 – Heike Kamerlingh Onnes: superconductivity.

1914 - James Franck and Gustav Ludwig Hertz conduct the Franck–Hertz experiment demonstrating quantization of atomic ionization energy.

1919 – Arthur Eddington: Our sun as gravitational lens, a proof of the theory of relativity.

1920 – Otto Stern and Walter Gerlach conduct the Stern–Gerlach experiment, which demonstrates particle spin.

1920 – John B. Watson and Rosalie Rayner conduct the Little Albert experiment.

1928 – Griffith's experiment shows that living cells can be transformed via a transforming principle, later discovered to be DNA.

1934 – Enrico Fermi splits the atom.

1935 – Lady tasting tea experiment by Ronald A. Fisher, foundational in statistical hypothesis testing.

1940 – Karl von Frisch decodes the "dance" honeybees use to communicate the location of flowers.

1944 – Barbara McClintock breeds maize plants for color, which leads to the discovery of jumping genes.

1947 – John Bardeen and Walter Brattain fabricate the first working transistor.
• 1951 – Solomon Asch shows how group pressure can persuade an individual to conform to an obviously wrong opinion.

• 1952 – Alfred Hershey & Martha Chase: Hershey–Chase experiment proves that DNA is the hereditary material.

• 1953 – Stanley L. Miller & Harold C. Urey: Miller–Urey experiment demonstrates that organic compounds can arise spontaneously from inorganic ones.

• 1955 – Clyde L. Cowan and Frederick Reines confirm the existence of the neutrino in the neutrino experiment.

• 1958 – Meselson–Stahl experiment proves that DNA replication is semiconservative.


• 1961 – Crick, Brenner et al. experiment.

• 1961 – Nirenberg and Matthaei experiment.

• 1964 – Nirenberg and Leder experiment.


• 1967 – Kerim Kerimov launches the Cosmos 186 and Cosmos 188 as experiments on automatic docking eventually leading to the development of space stations.

• 1970 – Allan and Beatrix Gardner teach American Sign Language to the chimpanzee Washoe.

• 1974 – Stanley Milgram: Milgram experiment on obedience to authority.


Timeline of the history of scientific method

• c. 1600 BC — The Edwin Smith Papyrus, an Egyptian surgical textbook, which applies: examination, diagnosis, treatment and prognosis, to injuries, paralleling rudimentary empirical methodology.

• 624 - 548 BC — Thales raised the study of nature from the realm of the mythical to the level of empirical study.

• 610 - 547 BC — Anaximander extends the idea of "law" to the physical world and uses maps and models.

• c. 400 BC — In China, Mozi and the School of Names advocate using one's senses to observe the world, and develop the "three-prong method" for testing the truth or falsehood of statements.

• c. 400 BC — Democritus advocates inductive reasoning through a process of examining the causes of sensory perceptions and drawing conclusions about the outside world.
• c. 400 BC — Plato first provides a detailed definitions for idea, matter, form and appearance as abstract concepts.

• c. 320 BC — First comprehensive documents categorising and subdividing knowledge, dividing knowledge into different areas by Aristotle. (physics, poetry, zoology, logic, rhetoric, politics, and biology). Aristotle's Posterior Analytics defends the ideal of science as necessary demonstration from axioms known with certainty. Aristotle believes that the world is real and that we can learn the truth by experience.

• c. 341-270 BC — Epicurus scientific method with multiple variables.

• c. 300 BC — Euclid's Elements expound geometry as a system of theorems following logically from axioms known with certainty.

• c. 240 BC — Eratosthenes best known for being the first person to calculate the circumference of the Earth, which he did by applying a measuring system using stadia, which was a standard unit of measure during that time period. His calculation was remarkably accurate.

• c. 200 BC — First Cataloged library (at Alexandria)

• c. 150 BC — The Book of Daniel describes a clinical trial proposed by Daniel in which he and his three companions eat vegetables and water for 10 days rather than the royal food and wine.

• c. 90-168 — Claudius Ptolemy

• c. 721-873 — Muslim scientists used experiment and quantification to distinguish between competing scientific theories, set within a generically empirical orientation, as can be seen in the works of Jābir ibn Hayyān (721–815) and Alkindus (801–873).

• 1021 — Ibn al-Haytham introduces the experimental method and combines observations, experiments and rational arguments in his Book of Optics.

• c. 1025 — Abū Rayhān al-Bīrūnī, develops experimental methods for mineralogy and mechanics, and conducts elaborate experiments related to astronomical phenomena.

• 1027 — In The Book of Healing, Avicenna criticizes the Aristotelian method of induction, arguing that "it does not lead to the absolute, universal, and certain premises that it purports to provide", and in its place, develops examination and experimentation as a means for scientific inquiry.

• 1220–1235 — Robert Grosseteste, an English scholastic philosopher, theologian and the bishop of Lincoln, published his Aristotelian commentaries, which laid out the framework for the proper methods of science.

• 1265 — Roger Bacon, an English monk, inspired by the writings of Grosseteste, described a scientific method, which he based on a repeating cycle of observation, hypothesis, experimentation, and the need for independent verification. He recorded the manner in which he conducted his experiments in precise detail so that others could reproduce and independently test his results.

• 1327 — Ockham's razor clearly formulated (by William of Ockham) which states that among competing hypotheses, the one with the fewest assumptions should be selected.
• 1403 — Yongle Encyclopedia, the first collaborative encyclopedia
• 1581 — Francisco Sanches uses classical skeptical arguments to show that science, in the Aristotelian sense of giving necessary reasons or causes for the behavior of nature, cannot be attained.
• 1581 — Tycho Brahe builds large scale research facility, Stjerneborg dedicated to obtaining high precision measurements of the planets.
• 1595 — Microscope invented in the Netherlands
• 1600 — First dedicated laboratory
• 1608 — Telescope invented in the Netherlands
• 1620 — Novum Organum published, (Francis Bacon)
• 1637 — First Scientific method (René Descartes)
• 1638 — Galileo's Two New Sciences published, containing two thought experiments, namely Galileo's Leaning Tower of Pisa experiment and Galileo's ship, which are intended to disprove existing physical theories by showing that they have contradictory consequences.
• 1650 — Society of experts (the Royal Society)
• 1650 — Experimental evidence established as the arbiter of truth (the Royal Society)
• 1665 — Repeatability established (Robert Boyle)
• 1665 — Scholarly journals established
• 1675 — Peer review begun
• 1687 — Hypothesis/prediction (Isaac Newton)
• 1739 — David Hume's Treatise of Human Nature argues that the problem of induction is unsolvable.
• 1753 — First description of a controlled experiment using identical populations with only one variable: James Lind's research into Scurvy among sailors.
• 1763 — Reverend Thomas Bayes published An Essay towards solving a Problem in the Doctrine of Chances laying the basis for Bayesian inference, a method of inference used to update the probability estimate for a hypothesis as additional evidence is acquired.
• 1812 — The formulation by Hans Christian Ørsted of the Latin-German mixed term Gedankenexperiment (lit. experiment conducted in the thoughts, or thought experiment). Although the method had been in use by philosophers since antiquity.
• 1815 — An optimal design for polynomial regression is published by Joseph Diaz Gergonne.
• 1833 - William Whewell invents the term scientist. They had previously been known as natural philosophers or men of science.
• 1840 - William Whewell in Philosophy of the Inductive Sciences coins the term "consilience" the principle that evidence from independent, unrelated sources can "converge" to strong conclusions.
- 1877–1878 — Charles Sanders Peirce publishes "Illustrations of the Logic of Science", popularizing his trichotomy of Abduction, Deduction and Induction. Peirce explains randomization as a basis for statistical inference.
- 1885 — C. S. Peirce with Joseph Jastrow first describes blinded, randomized experiments, which become established in psychology.
- 1897 — Thomas Chrowder Chamberlin proposes the use of multiple hypotheses to assist in the design of experiments.
- 1905 — Albert Einstein proposes the Theory of Relativity
- 1926 — Randomized design popularized and analyzed by Ronald Fisher (following Peirce)
- 1934 — Falsifiability as a criterion for evaluating new hypotheses is popularized by Karl Popper's The Logic of Scientific Discovery (following Peirce)
- 1937 — Controlled placebo trial
- 1946 — First computer simulation
- 1950 — Double blind experiment
- 1962 — Meta study of scientific method (Thomas Kuhn's The Structure of Scientific Revolutions)
- 1964 — Strong inference proposed by John R. Platt
- 2009 — Adam - First working prototype of a "robot scientist" able to perform independent experiments to test hypotheses and interpret findings without human guidance.
- 2012 — Constructor theory, a proposal for a new mode of explanation in fundamental physics, was first sketched out by David Deutsch.

**Timeline of Polish science and technology**

- Poland joins the European Southern Observatory ESO (2014), 16-nation intergovernmental research organisation for astronomy.
- PW-Sat - the first Polish satellite launched into space (2012); other Polish satellites include Lem and Heweliusz
- Krzysztof Matyjaszewski, a Polish-American chemist, discoverer of **atom-transfer radical polymerization**
- Bohdan Paczyński, a Polish astronomer, credited with the development of a new method of detecting space objects and establishing their mass using the gravitational lenses effect; he is acknowledged for coining the term **microlensing**
Graphene acquisition - In 2011 the Institute of Electronic Materials Technology and Department of Physics, Warsaw University announced a joint development of acquisition technology of large pieces of graphene with the best quality so far. In April the same year, Polish scientists with support from the Polish Ministry of Economy began the procedure for granting a patent to their discovery around the world.

Blue laser - first blue laser in Poland (third in the world)

Artificial heart - an implant, program: "Polish Artificial Heart"

PSR 1257+12 - a pulsar located 2,630 light years from Earth. It is believed to be orbited by at least four planets. These were the first extrasolar planets ever discovered (by a Polish astronomer, Aleksander Wolszczan, in 1992). Polish astronomy has traditionally been among the best in the world.

Jack Tramiel, a Polish American businessman, best known for founding Commodore International; Commodore PET, Commodore VIC-20 and Commodore 64 are some home computers produced while he was running the company

Foundation For Polish Science - a non-governmental organisation aiming at supporting academics with high potential - since (1991)

PZL W-3 Sokół - a helicopter, FAA certificate in (1989)

Henryk Magnuski, a Polish telecommunications engineer who worked for Motorola in Chicago. He was the inventor of the first Walkie-Talkies and one of the authors of his company success in the fields of radio communication

Benoit Mandelbrot, mathematician of Polish descent; known for developing a theory of "roughness and self-similarity" and significant contributions to fractal geometry and chaos theory; Mandelbrot set

Flaris LAR01, a Polish five-seat single-engined very light jet, currently under development by Metal-Master of Jelenia Góra

Solaris Urbino 18 Hybrid, a low-floor articulated hybrid buses from the Solaris Urbino series for city communication services manufactured by Solaris Bus & Coach in Bolechowo near Poznań in Poland

PZL Kania - a helicopter, first prototype (1979), FAR-29 certificate (early 1980s)

Odra (computer) - a line of computers manufactured in Wrocław (1959/1960)

K-202- first Polish microcomputer invented by Jacek Karpinski (1971)

FB MSBS, an assault rifle developed by FB "Łucznik" Radom

FB Beryl, an assault rifle designed and produced by the Łucznik Arms Factory in the city of Radom

Polish Polar Station, Hornsund - since (1957)

PZL SW-4 Puszczyk - a Polish light single-engine multipurpose helicopter manufactured by PZL Swidnik

EP-09 - 'B0B0' Polish electric locomotive class
PT-91 - a Polish main battle tank. Designed at the Research and Development Centre of Mechanical Systems OBRUM (Ośrodek Badawczo-Rozwojowy Urządzeń Mechanicznych) in Gliwice

- Grom (missile) - an anti-aircraft missile
- 206FM - class minesweeper (NATO: "Krogulec")
- Meteor (rocket)- a series of sounding rockets (1963)
- PZL TS-11 Iskra - a jet trainer aircraft, used by the air forces of Poland and India (1960)
- Lim-6 - attack aircraft (1955)
- Mizar system, a system consisting of a formal language for writing mathematical definitions and proofs, a proof assistant, which is able to mechanically check proofs written in this language, and a library of formalized mathematics, which can be used in the proof of new theorems; it was designed by Polish mathematician Andrzej Trybulec in 1973
- Mieczysław G. Bekker, a Polish engineer and scientist, co-authored the general idea and contributed significantly to the design and construction of the Lunar Roving Vehicle used by missions Apollo 15, Apollo 16, and Apollo 17 on the Moon
- The Polish Academy of Sciences, headquartered in Warsaw, was founded in 1952.
- Hilary Koprowski, Polish virologist and immunologist, inventor of the world's first effective live polio vaccine
- Andrzej Udalski, initiator of the OGLE project, which led to the such significant discoveries as the detection of the first merger of a binary star, first Cepheid pulsating stars in the eclipsing binary systems, unique Nova systems, quazars and galaxies
- Stefania Jabłońska, Polish physician; in 1972 Jabłońska proposed the association of the human papilloma viruses with skin cancer in epidermodysplasia verruciformis; in 1978 Jabłońska and Gerard Orth at the Pasteur Institute discovered HPV-5 in skin cancer; Jabłońska was awarded the 1985 Robert Koch Prize
- Andrew Schally, Polish-American endocrinologist and Nobel Prize laureate
- Tomasz Dietl, a Polish physicist; known for developing the theory, confirmed in recent years, of diluted ferromagnetic semiconductors, and for demonstrating new methods in controlling magnetization
- Ryszard Horodecki, a Polish physicist; he contributed largely to the field of quantum informatics and theoretical physics; Peres-Horodecki criterion
- Andrzej Szczeklik, a Polish immunologist; credited with discovering the anti-thrombotic properties of aspirin, and studies on the pathogenesis and treatment of aspirin-induced bronchial asthma
- Antoni Zygmund, a Polish mathematician, considered one of the greatest analysts of the 20th century
- Leonid Hurwicz, a Polish economist and mathematician; he originated incentive compatibility and mechanism design, which show how desired outcomes are achieved in economics, social science and political science
- Artur Ekert, a Polish physicist; one of the inventors of quantum cryptography
- Jacek Pałkiewicz, a Polish journalist, traveler and explorer; fellow of the Royal Geographical Society, discoverer of the sources of the Amazon River
- Kazimierz Kuratowski, a Polish mathematician, a leading representative of the Warsaw School of Mathematics; Kuratowski's theorem, Kuratowski-Zorn lemma; Kuratowski closure axioms
- Tadek Marek, a Polish automobile engineer, known for his Aston Martin engines
- Otto Marcin Nikodym, a Polish mathematician; Radon-Nikodym theorem
- Zygmunt Bauman, a Polish sociologist and philosopher; one of the world's most eminent social theorists writing on issues as diverse as modernity and the Holocaust, postmodern consumerism as well as the concept of liquid modernity which he introduced
- Kazimierz Dąbrowski, a Polish psychologist; he developed the theory of positive disintegration, which describes how a person's development grows as a result of accumulated experiences
- Anna Wierzbicka, a Polish linguist; known for her work in semantics, pragmatics and cross-cultural linguistics; she's credited with formulating the theory of natural semantic metalanguage and the concept of semantic primes
- Andrzej Grzegorczyk, a Polish mathematician; he introduced the Grzegorczyk hierarchy - a subrecursive hierarchy that foreshadowed computational complexity theory
- Stanisław Jaśkowski, a Polish mathematician; he is regarded as one of the founders of natural deduction, which he discovered independently of Gerhard Gentzen in the 1930s; he was among the first to propose a formal calculus of inconsistency-tolerant (or paraconsistent) logic; furthermore, Jaśkowski was a pioneer in the investigation of both intuitionistic logic and free logic.
- Karol Borsuk, a Polish mathematician; his main area of interest was topology; he introduced the theory of absolute retracts (ARs) and absolute neighborhood retracts (ANRs), and the cohomotopy groups, later called Borsuk–Spanier cohomotopy groups; he also founded shape theory; Borsuk's conjecture, Borsuk-Ulam theorem
- Jerzy Konorski, a Polish neurophysiologist; he discovered secondary conditioned reflexes and operant conditioning and proposed the idea of gnostic neurons - a concept similar to the grandmother cell; he also coined the term neural plasticity, and he developed theoretical ideas regarding it
- Antoni Kępiński, a Polish psychiatrist; he developed the psychological theory of information metabolism which explores human social interactions based on information processing which significantly influenced the development of socionics
- Zbigniew Religa, a Polish cardiac surgeon; a pioneer in human heart transplantation; in 1987 he performed the first successful heart transplant in Poland; in 1995 he was the first surgeon to graft an artificial valve created from materials taken from human corpses; in 2004 Religa and his team developed an implantable pump for a pneumatic heart assistance system
- Maria Siemionow, a renowned Polish transplantation surgeon and scientist who gained world recognition when she led a team of eight surgeons through the world's first near-total face transplant at the Cleveland Clinic in 2008
- Tadeusz Krwawicz, a Polish ophthalmologist; he pioneered the use of cryosurgery in ophthalmology; he was the first to describe a method of cataract extraction by cryoadhesion in 1961, and to develop a probe by means of which cataracts can be grasped and extracted
- Albert Sabin, a Polish-American medical researcher, best known for developing the oral polio vaccine which has played a key role in nearly eradicating the disease
- Stefan Kudelski, a Polish audio engineer known for creating the Nagra series of professional audio recorders
- Zdzisław Pawlak, a Polish mathematician and computer scientist; known for his contribution to many branches of theoretical computer science; he is credited with introducing the rough set theory and also known for his fundamental works on it; he had also introduced the Pawlak flow graphs, a graphical framework for reasoning from data
- Jan Czekanowski, a Polish anthropologist, ethnographer, statistician and linguist; one of the founders of computational linguistics, he introduced the Czekanowski binary index
- Henryk Iwaniec, mathematician, he is noted for his outstanding contributions to analytic number theory and sieve theory; Friedlander-Iwaniec theorem
- **Polish mine detector** was a metal detector used for detecting land mines, developed during World War II (1941–42) by Polish Lieutenant Józef Stanisław Kozacki. It contributed substantially to British Field Marshal Bernard Montgomery's 1942 victory over German Field Marshal Erwin Rommel at El Alamein.
- **Cryptologic bomb** was a special-purpose machine designed in 1938 by Polish mathematician-cryptologist Marian Rejewski to speed the breaking of the Enigma machine ciphers that would be used by Nazi Germany in World War II. It was a forerunner of the "Bombes" that would be used by the British at Bletchley Park, and which would be a major element in the Allied Ultra program that may have decided the outcome of World War II.
- **Biuro Szyfrów (Cipher Bureau)** was the Polish military intelligence agency that made the first break (1932, just as Adolf Hitler was about to take power in Germany) into the German Enigma machine cipher that would be used by Nazi Germany through World War II, and kept reading Enigma ciphers at least until France's capitulation in June 1940.
- **Czochralski process** - a method of crystal growth used to obtain single crystals of semiconductors (e.g. silicon, germanium and gallium arsenide), metals (e.g. palladium, platinum, silver, gold) and salts (1916)
- Joseph Rotblat, Polish physicist who worked on the Manhattan Project, Nobel Laureate
Stanisław Ulam, a Polish-American mathematician who participated in America’s, Manhattan Project, originated the Teller–Ulam design of thermonuclear weapons, discovered the concept of cellular automaton, invented the Monte Carlo methods of computation, and suggested nuclear pulse propulsion.

Wacław Struszyński, a Polish electronics engineer who made a vital contribution to the defeat of U-boats in the Battle of the Atlantic, he designed a radio antenna which enabled effective high frequency (HF) radio direction finding systems to be installed on Royal Navy convoy escort ships. Such direction finding systems were referred to as HF/DF or Huff-Duff, and enabled the bearings of U-boats to be determined when the U-boats made high frequency radio transmissions.

Vickers Tank Periscope MK.IV - the first device to allow the tank commander to have a 360-degree view from his turret, invented by engineer Rudolf Gundlach (1936)

Polish notation - also known as prefix notation, is a method of mathematical expression (1920)

Reverse Polish notation - (RPN), also known as postfix notation (1920)

Zygalski sheets, also known as "perforated sheets" (invented in 1938 by Henryk Zygalski), were one of a number of devices created by the Polish Cipher Bureau to facilitate the breaking of German Enigma ciphers.

Stefan Banach - mathematician, Banach space, Banach-Tarski paradox, Banach algebra, Functional analysis

Lwów School of Mathematics was a group of eminent Polish mathematicians that included Hugo Steinhaus, Stanisław Ulam, Mark Kac and many more.

Tadeusz Banachiewicz, a Polish astronomer, inventor of the chronocinematograph

7TP - light tank of the Second World War (1935)

FB Vis, a 9×19 mm caliber, single-action, semi-automatic pistol

PZL.23 Karaś - light bomber and reconnaissance aircraft designed in the PZL (1934)

PZL P.11, a Polish fighter aircraft, designed by Zygmunt Pulawski in the early 1930s by PZL in Warsaw; it was briefly the most advanced fighter aircraft of its kind in the world

PZL.37 Łoś - twin-engine medium bomber designed in the PZL by Jerzy Dąbrowski (mid-1930s)

LWS-6 Żubr - initially a passenger plane. Since the Polish airline LOT bought Douglas DC-2 planes instead, the project was converted to a bomber aircraft (early-1930s)

SS Sołdek - the first ship built in Poland after World War II (1948)

Mieczysław Wolske - "one of precursors in the development of holography" (a quote from Dennis Gabor)

Hugo Steinhaus, a Polish mathematician; one of the founders of the Lwów School of Mathematics, he is regarded as one of the early founders of game theory and probability theory which led to later development of more comprehensive approaches by other scholars; Banach-Steinhaus theorem
LWS - an abbreviation name used by Polish aircraft manufacturer Lubelska Wytwórnia Samolotów (1936–1939)

PZL - an abbreviation name used by Polish aerospace manufacturers (1928–present)

RWD - an abbreviation name used by Polish aircraft manufacturer (1920–1940)

TKS - a tankette (1931)

Stetysz (1929) - Polish automobile manufacture by engineer and inventor, Stefan Tyszkiewicz

RWD-1 - sports plane of 1928, constructed by the RWD

Wz. 35 anti-tank rifle, a Polish 7.9 mm anti-tank rifle used by the Polish Army during the Invasion of Poland of 1939

Marian Smoluchowski a Polish scientist, pioneer of statistical physics - *Einstein–Smoluchowski relation, Smoluchowski coagulation equation, **Feynman-Smoluchowski ratchet**

Kazimierz Fajans, a Polish physical chemist, the discoverer of chemical element **protactinium**

Kazimierz Funk, a Polish biochemist, credited with formulating the concept of **vitamines**

Alfred Tarski, a renowned Polish logician, mathematician and philosopher; **Banach-Tarski paradox**, Tarski's undefinability theorem, formal notion of truth

Waclaw Sierpinski, known for outstanding contributions to set theory (research on the axiom of choice and the continuum hypothesis), number theory, theory of functions and topology; **Sierpinski triangle**, Sierpinski carpet, Sierpinski curve, **Sierpinski number**

Aleksander Jabłoński, a Polish physicist, known for Jablonski diagram

Josef Hofmann, designer of first **windscreen wipers**

Rudolf Weigl, a Polish biologist and inventor of the first effective vaccine against epidemic typhus

Ludwik Hirszfeld, a Polish microbiologist and serologist. He is considered a co-discoverer of the inheritance of ABO blood types

Stephanie Kwolek, American chemist of Polish origin, inventor of **Kevlar**

Andrzej Tarkowski, a Polish embryologist and Professor of Warsaw University, known for his pioneering researches on embryos and blastomeres, which have created theoretical and practical basis for achievements of biology and medicine of the twentieth century - in vitro fertilization, cloning and stem cell discovery

Michał Kalecki, a Polish economist; he has been called "one of the most distinguished economists of the 20th century", he made major theoretical and practical contributions in the areas of the business cycle, growth, full employment, income distribution, the political boom cycle, the oligopolistic economy, and risk; he offered a synthesis that integrated Marxist class analysis and the then-new literature on oligopoly theory, and his work had a significant influence on both the Neo-Marxian and Post-
Keynesian schools of economic thought; he was also one of the first macroeconomists to apply mathematical models and statistical data to economic questions.

- Stefan Bryła, a Polish construction engineer and welding pioneer; he designed and built the first welded road bridge in the world as well as the Prudential building in Warsaw, one of the first European skyscrapers
- Ralph Modjeski, a Polish civil engineer who achieved prominence as a pre-eminent bridge designer in the United States
- Wojciech Świętosławski, Polish chemist and physicist, considered the father of thermochemistry
- Józef Tykociński, a Polish engineer and a pioneer of sound-on-film technology
- Tadeusz Sędzimir, a Polish engineer and inventor in the field of mining and metallurgy
- Mieczysław Mąkosza, a Polish chemist specializing in organic synthesis and investigation of organic mechanisms; he is credited for the discovery of the aromatic vicarious nucleophilic substitution, VNS; he also contributed to the discovery of phase transfer catalysis reactions
- Bronisław Malinowski, a Polish anthropologist, often considered one of the most important 20th-century anthropologists; participatory observation
- Mirosław Hermaszewski, a Polish Air Force officer and cosmonaut; the first Polish person in space
- Henryk Arctowski, a Polish scientist, explorer and an internationally renowned meteorologist; a pioneer in the exploration of Antarctica
- Józef Paczoski, a Polish botanist; he coined the term of phytosociology and was one of the founders of this branch of botany
- Stefan Drzewiecki, a Polish scientist, journalist, engineer, constructor and inventor; he developed several models of propeller-driven submarines that evolved from single-person vessels to a four-man model; he developed the theory of gliding flight, developed a method for the manufacture of ship and plane propellers (1892), and presented a general theory for screw-propeller thrust (1920); he also developed several models of early submarines for the Russian Navy, and devised a torpedo-launching system for ships and submarines that bears his name, the Drzewiecki drop collar; he also made an instrument that drew the precise routes of ships onto a nautical chart; his work Théorie générale de l'hélice (1920), was honored by the French Academy of Science as fundamental in the development of modern propellers.
- Tadeusz Tański, a Polish automobile engineer and the designer of, among others, the first Polish serially-built automobile, the CWS T-1
- Leonard Danilewicz, a Polish engineer, he came up with a concept for a frequency-hopping spread spectrum
- Florian Znaniecki, a Polish sociologist and philosopher; he made significant contributions to sociological theory and introduced such concepts as humanistic coefficient and culturalism; he is the co-author of The Polish Peasant in Europe and America, which is considered the foundation of modern empirical sociology
• Adolf Beck, a Polish physiologist, a pioneer of electroencephalography (EEG); in 1890 he published an investigation of spontaneous electrical activity of the brain of rabbits and dogs that included rhythmic oscillations altered by light; Beck started experiments on the electrical brain activity of animals; his observation of fluctuating brain activity led to the conclusion of brain waves

• Andrzej Schinzel, a Polish mathematician, studying mainly number theory; Schinzel's hypothesis H, Davenport–Schinzel sequence

• Władysław Staręwicz, a Polish-Russian pioneering film director and stop-motion animator, he is notable as the author of the first puppet-animated film i.e. The Beautiful Lukanida (1912)

• Walery Jaworski, one of the pioneers of gastroenterology in Poland; he described bacteria living in the human stomach and speculated that they were responsible for stomach ulcers, gastric cancer and achylia. It was one of the first observations of Helicobacter pylori. He published those findings in 1899 in a book titled "Podręcznik chorób żołądką" ("Handbook of Gastric Diseases"). His findings were independently confirmed by Robin Warren and Barry Marshall, who received the Nobel Prize in 2005

• Witold Hurewicz, a Polish mathematician; Hurewicz space, Hurewicz theorem

• Józef Wierusz-Kowalski, a Polish physicist, discoverer of the phenomenon of progressive phosphorescence

• Maria Skłodowska-Curie - a Polish chemist and physicist, a pioneer in the field of radioactivity, co-discoverer of the chemical elements radium and polonium

• Zygmunt Florenty Wróblewski and Karol Olszewski - the first to liquefy oxygen, nitrogen and carbon dioxide from the atmosphere in a stable state (not, as had been the case up to then, in a dynamic state in the transitional form as vapour) (1833)

• Ignacy Łukasiewicz - a Polish pharmacist and petroleum industry pioneer who in 1856 built the world's first oil refinery; his achievements included the discovery of how to distill kerosene from seep oil, the invention of the modern kerosene lamp, the introduction of the first modern street lamp in Europe, and the construction one of the world's first modern oil well

• The Polish Academy of Learning, an academy of sciences, was founded in Kraków in 1872.

• Stefan Drzewiecki built in 1884 the world's first electric submarine.

• Casimir Zeglen, inventor of one of the first bulletproof vests

• Jan Szczepanik, a Polish inventor, with several hundred patents and over 50 discoveries to his name, many of which are still applied today, especially in the motion picture industry, as well as in photography and television, which include telectroscope and colorimeter

• Edmund Biernacki, a Polish pathologist, known for the Biernacki reaction used worldwide to assess erythrocyte sedimentation rate (ESR), which is one of the major blood tests

• Ludwik Gumplowicz, a Polish sociologist, "one of the founders of European sociology"

• Antoni Leśniowski, a Polish surgeon, discoverer of Leśniowski-Crohn's disease
• Edward Flatau, a Polish neurologist and psychiatrist, his name in medicine is linked to Redlich-Flatau syndrome, Flatau-Sterling torsion dystonia, Flatau-Schidler disease and Flatau's law. He published a human brain atlas (1894), wrote a fundamental book on migraine (1912), established the localization principle of long fibers in the spinal cord (1893), and with Sterling published an early paper (1911) on progressive torsion spasm in children and suggested that the disease has a genetic component.

• Kazimierz Prószyński, a Polish inventor active in the field of cinema; he patented his first film camera, called Pleograph, before the Lumière brothers, and later went on to improve the cinema projector for the Gaumont company, as well as invent the widely used hand-held Aeroscope camera.

• Mikhail Dolivo-Dobrovolsky, a Polish-Russian engineer and electrician; inventor of the three-phase electric power system.

• Joseph Babinski, a neurologist best known for his 1896 description of the Babinski sign, a pathological plantar reflex indicative of corticospinal tract damage.

• Jan Baudouin de Courtenay, a Polish linguist, he formulated the theory of the phoneme and phonetic alternations.

• Ernest Malinowski, a Polish engineer, he constructed at that time the world's highest railway Ferrocarril Central Andino in the Peruvian Andes in 1871–1876.

• Bruno Abakanowicz, a Polish mathematician and electrical engineer, inventor of the integragraph, spirograph and parabolaphigraph.

• Stanisław Kierbedź, a Polish-Russian engineer, and military officer; he constructed the first permanent iron bridge over the Vistula River in Warsaw known as the Kierbedź Bridge; he designed and supervised the construction of dozens of bridges, railway lines, ports and other objects in Central and Eastern Europe.

• Felicjan Sypniewski, a Polish naturalist, botanist, entomologist and philosopher; his ground-breaking studies and scientific publications laid down the foundations of malacology.

• Ludwik Zamenhof, a Polish medical doctor, inventor and writer; creator of Esperanto, the most successful constructed language in the world.

• Napoleon Cybulski, a Polish physiologist and a pioneer of endocrinology and electroencephalography; discoverer of adrenaline.

• Waclaw Mayzel, a Polish histologist; he described for the first time the process of mitosis.

• Antoni Patek, a Polish pioneer in watchmaking and a creator of Patek Philippe & Co., one of the most famous watchmaker companies in the world.

• Ludwik Rydygier, a Polish surgeon; in 1880, as the first in Poland and second in the world he succeeded in surgical removal of the pylorus in a patient suffering from stomach cancer, he was also the first to document this procedure; in 1881, as the first in the world, he carried out a peptic ulcer resection; in 1884 he introduced a new method of surgical peptic ulcer treatment using Gastroenterostomy; Rydygier...
proposed (1900) original concepts for removing prostatic adenoma and introduced many other surgical techniques that are successfully used to date

- Jan Dzierżoń, a pioneering Polish apiarist who discovered the phenomenon of parthenogenesis in bees and designed the first successful movable-frame beehive; his discoveries and innovations made him world-famous in scientific and bee-keeping circles; he has been described as "the father of apiculture"

- Ignacy Domeyko - geologist and mineralogist, a geological map of Chile, describing the Jurassic rock formations, and discovered deposits of a rare mineral (1846)

- Paweł Strzelecki, a Polish explorer and geologist; in 1840 he climbed the highest peak on mainland Australia and named it Mount Kosciuszko; he made a geological and mineralogical survey of the Gippsland region in present-day eastern Victoria and from 1840 to 1842 he explored nearly every part of Tasmania; author of Physical Description of New South Wales (1845)

- Julian Ursyn Niemcewicz - scholar, poet, and statesman

- Ignacy Prądzyński, a Polish military commander and general; principal engineer and designer of the Augustów Canal

- Wojciech Jastrzębowski, a Polish scientist, naturalist and inventor, professor of botany, physics, zoology and horticulture; considered as one of the fathers of ergonomics

- **Commission of National Education** (Polish: Komisja Edukacji Narodowej), founded in 1773, was the world's first national Ministry of Education.

- Stanisław Staszic was an outstanding Polish philosopher, statesman, Catholic priest, geologist, translator, poet and writer — almost a one-man academy of sciences. The Polish Academy of Sciences' Staszic Palace, in Warsaw, is named after him; one of the founding fathers of the **Constitution of May 3, 1791** - the world's second and Europe's first written constitution and a crowning achievement of the Polish Enlightenment

- Józef Maria Hoene-Wroński, a Polish Messianist philosopher, mathematician, physicist, inventor, lawyer, and economist; he is credited with formulating the Wronskian

- Johannes Hevelius was an outstanding astronomer who published the earliest exact maps of the moon and the most complete star catalog of his time, containing 1,564 stars. In 1641 he built an observatory in his house; he is known as "the founder of lunar topography"

- Jan Brożek (Ioannes Broscius) was the most prominent 17th-century Polish mathematician. Following his death, his collection of Nicolaus Copernicus' letters and documents, which he had borrowed 40 years earlier with the intent of writing a biography of Copernicus, was lost.

- Kazimierz Siemienowicz, a Polish–Lithuanian general of artillery, gunsmith, military engineer, and pioneer of rocketry
Michał Boym, a Polish Jesuit missionary to China, scientist and explorer; he is notable as one of the first westerners to travel within the Chinese mainland, and the author of numerous works on Asian fauna, flora and geography.

Krzysztof Arciszewski, a Polish–Lithuanian nobleman, military officer, engineer, and ethnographer. Arciszewski also served as a general of artillery for the Netherlands and Poland.

Jan Jonston, a Polish scholar and physician of Scottish descent; author of Thautomatographia naturalis (1632) and Idea universae medicinae practicae (1642).

Michał Sędziwój, a Polish alchemist, philosopher, and medical doctor; a pioneer of chemistry, he developed ways of purification and creation of various acids, metals and other chemical compounds; he discovered that air is not a single substance and contains a life-giving substance—later called oxygen 170 years before similar discoveries by Scheele and Priestley; he correctly identified this 'food of life' with the gas (also oxygen) given off by heating nitre (saltpetre); this substance, the 'central nitre', had a central position in Sendivogius' schema of the universe.

Bartholomäus Keckermann - A Short Commentary on Navigation (the first one written in Poland).

Josephus Struthius - published in 1555 Sphygmicae artis iam mille ducentos perditae et desideratae libri V. in which he described five types of pulse, the diagnostic meaning of those types, and the influence of body temperature and nervous system on pulse. This was one of books used by William Harvey in his works.

Sebastian Petrycy; a Polish philosopher and physician who lectured and published notable works in the field of medicine.


Nicolaus Copernicus was a true Renaissance polymath — an astronomer, mathematician, physician, lawyer, clergyman, governor, diplomat, military leader, classics scholar and economist, who developed the heliocentric theory in a form detailed enough to make it scientifically useful, and described "Gresham's Law" the year (1519) that Thomas Gresham was born.

Marcin of Urzędów, a Polish Roman Catholic priest, physician, pharmacist and botanist known especially for his Herbarz polski ("Polish Herbal").

Adam of Łowicz, a Polish physician, philosopher, and humanist; author of Fundamentum scientiae nobilissimae secretorum naturae.

Albert Brudzewski, a Polish astronomer, mathematician, philosopher and diplomat; known for establishing the moon's elliptical orbit; author of Commentum planetarium in theoricas Georgii Purbachii.

Kraków Academy (Akademia Krakowska) founded in 1364 by King Kazimierz the Great.

Witelo (ca. 1230 – ca. 1314) was an outstanding philosopher and a scientist who specialized in optics. His famous optical treatise, Perspectiva, which drew on the Arabic Book of Optics by Alhazen, was unique.
in Latin literature and helped give rise to Roger Bacon's best work. In addition to optics, Witelo's treatise made important contributions to the psychology of visual perception.

Timeline of black hole physics

- 1640 — Ismaël Bullialdus suggests an inverse-square gravitational force law
- 1676 — Ole Rømer demonstrates that light has a finite speed
- 1684 — Isaac Newton writes down his inverse-square law of universal gravitation
- 1758 — Rudjer Josip Boscovich develops his theory of forces, where gravity can be repulsive on small distances. So according to him strange classical bodies, such as white holes, can exist, which won't allow other bodies to reach their surfaces
- 1784 — John Michell discusses classical bodies which have escape velocities greater than the speed of light
- 1795 — Pierre Laplace discusses classical bodies which have escape velocities greater than the speed of light
- 1798 — Henry Cavendish measures the gravitational constant $G$
- 1876 — William Kingdon Clifford suggests that the motion of matter may be due to changes in the geometry of space
- 1909 — Albert Einstein, together with Marcel Grossmann, starts to develop a theory which would bind metric tensor $g$, which defines a space geometry, with a source of gravity, that is with mass
- 1910 — Hans Reissner and Gunnar Nordström defines Reissner–Nordström singularity, Hermann Weyl solves special case for a point-body source
- 1915 — Albert Einstein presents (David Hilbert has presented this independently five days earlier in Göttingen) the complete Einstein field equations at the Prussian Academy meeting in Berlin on 25 November 1915
- 1916 — Karl Schwarzschild solves the Einstein vacuum field equations for uncharged spherically-symmetric non-rotating systems
- 1917 — Paul Ehrenfest gives conditional principle a three-dimensional space
- 1918 — Hans Reissner and Gunnar Nordström solve the Einstein–Maxwell field equations for charged spherically-symmetric non-rotating systems
- 1918 — Friedrich Kottler gets Schwarzschild solution without Einstein vacuum field equations
- 1923 — George David Birkhoff proves that the Schwarzschild spacetime geometry is the unique spherically symmetric solution of the Einstein vacuum field equations
• 1931 — Subrahmanyan Chandrasekhar calculates, using special relativity, that a non-rotating body of electron-degenerate matter above a certain limiting mass (at 1.4 solar masses) has no stable solutions

• 1939 — Robert Oppenheimer and Hartland Snyder calculate the gravitational collapse of a pressure-free homogeneous fluid sphere into a black hole

• 1958 — David Finkelstein theorises that the Schwarzschild radius is a causality barrier: an event horizon of a black hole

• 1963 — Roy Kerr solves the Einstein vacuum field equations for uncharged symmetric rotating systems, deriving the Kerr metric for a rotating black hole

• 1963 — Maarten Schmidt discovers and analyzes the first quasar, 3C 273, as a highly red-shifted active galactic nucleus, a billion light years away

• 1964 — Roger Penrose proves that an imploding star will necessarily produce a singularity once it has formed an event horizon

• 1964 — Yakov Zel’dovich and independently Edwin Salpeter propose that accretion discs around supermassive black holes are responsible for the huge amounts of energy radiated by quasars

• 1964 — Hong-Yee Chiu coins the word quasar for a ‘quasi-stellar radio source’ in his article in Physics Today

• 1964 — The first recorded use of the term "black hole", by journalist Ann Ewing


• 1966 — Yakov Zel’dovich and Igor Novikov propose searching for black hole candidates among binary systems in which one star is optically bright and X-ray dark and the other optically dark but X-ray bright (the black hole candidate)

• 1967 — Jocelyn Bell discovers and analyzes the first radio pulsar, direct evidence for a neutron star

• 1967 — Werner Israel presents the proof of the no-hair theorem at King's College London

• 1967 — John Wheeler introduces the term "black hole" in his lecture to the American Association for the Advancement of Science

• 1968 — Brandon Carter uses Hamilton–Jacobi theory to derive first-order equations of motion for a charged particle moving in the external fields of a Kerr–Newman black hole

• 1969 — Roger Penrose discusses the Penrose process for the extraction of the spin energy from a Kerr black hole

• 1969 — Roger Penrose proposes the cosmic censorship hypothesis

• 1972 — Identification of Cygnus X-1/HDE 226868 from dynamic observations as the first binary with a stellar black hole candidate
• 1972 — Stephen Hawking proves that the area of a classical black hole’s event horizon cannot decrease
• 1972 — James Bardeen, Brandon Carter, and Stephen Hawking propose four laws of black hole mechanics in analogy with the laws of thermodynamics
• 1972 — Jacob Bekenstein suggests that black holes have an entropy proportional to their surface area due to information loss effects
• 1974 — Stephen Hawking applies quantum field theory to black hole spacetimes and shows that black holes will radiate particles with a black-body spectrum which can cause black hole evaporation
• 1975 — James Bardeen and Jacobus Petterson show that the swirl of spacetime around a spinning black hole can act as a gyroscope stabilizing the orientation of the accretion disc and jets
• 1989 — Identification of microquasar V404 Cygni as a binary black hole candidate system
• 1994 — Charles Townes and colleagues observe ionized neon gas swirling around the center of our Galaxy at such high velocities that a possible black hole mass at the very center must be approximately equal to that of 3 million suns
• 2002 — Astronomers at the Max Planck Institute for Extraterrestrial Physics present evidence for the hypothesis that Sagittarius A* is a supermassive black hole at the center of the Milky Way galaxy
• 2002 — NASA’s Chandra X-ray Observatory identifies double galactic black holes system in merging galaxies NGC 6240
• 2004 — Further observations by a team from UCLA present even stronger evidence supporting Sagittarius A* as a black hole
• 2006 — The Event Horizon Telescope begins capturing data
• 2012 — First visual evidence of black-holes: Suvi Gezari’s team in Johns Hopkins University, using the Hawaiian telescope Pan-STARRS 1, publish images of a supermassive black hole 2.7 million light-years away swallowing a red giant
• 2015 — LIGO Scientific Collaboration detects the distinctive gravitational waveforms from a binary black hole merging into a final black hole, yielding the basic parameters (e.g., distance, mass, and spin) of the three spinning black holes involved
• 2019 — Event Horizon Telescope collaboration released the first direct photo of a black hole, the supermassive M87* at the core of the Messier 87 galaxy

Timeline of gravitational physics and relativity
- 3rd century BC - Aristarchus of Samos proposes heliocentric model, measures the distance to the Moon and its size
- 1543 – Nicolaus Copernicus places the Sun at the gravitational center, starting a revolution in science
- 1583 – Galileo Galilei induces the period relationship of a pendulum from observations (according to later biographer).
- 1586 – Simon Stevin demonstrates that two objects of different mass accelerate at the same rate when dropped.
- 1589 – Galileo Galilei describes a hydrostatic balance for measuring specific gravity.
- 1590 – Galileo Galilei formulates modified Aristotelean theory of motion (later retracted) based on density rather than weight of objects.
- 1602 – Galileo Galilei conducts experiments on pendulum motion.
- 1604 – Galileo Galilei conducts experiments with inclined planes and induces the law of falling objects.
- 1607 – Galileo Galilei arrives a mathematical formulation of the law of falling objects based on his earlier experiments.
- 1608 – Galileo Galilei discovers the parabolic arc of projectiles through experiment.
- 1609 – Johannes Kepler describes the motion of planets around the Sun, now known as Kepler's laws of planetary motion.
- 1640 – Ismaël Bullialdus suggests an inverse-square gravitational force law.
- 1665 – Isaac Newton introduces an inverse-square universal law of gravitation uniting terrestrial and celestial theories of motion and uses it to predict the orbit of the Moon and the parabolic arc of projectiles.
- 1684 – Isaac Newton proves that planets moving under an inverse-square force law will obey Kepler's laws
- 1686 – Isaac Newton uses a fixed length pendulum with weights of varying composition to test the weak equivalence principle to 1 part in 1000
- 1798 – Henry Cavendish measures the force of gravity between two masses, leading to the first accurate value for the gravitational constant
- 1846 – Urbain Le Verrier and John Couch Adams, studying Uranus' orbit, independently prove that another, farther planet must exist. Neptune was found at the predicted moment and position.
- 1855 – Le Verrier observes a 35 arcsecond per century excess precession of Mercury's orbit and attributes it to another planet, inside Mercury's orbit. The planet was never found. See Vulcan.
- 1876 – William Kingdon Clifford suggests that the motion of matter may be due to changes in the geometry of space
- 1882 – Simon Newcomb observes a 43 arcsecond per century excess precession of Mercury's orbit
- 1887 – Albert A. Michelson and Edward W. Morley in their famous experiment do not detect the ether drift
• 1889 – Loránd Eötvös uses a torsion balance to test the weak equivalence principle to 1 part in one billion
• 1893 – Ernst Mach states Mach's principle; first constructive attack on the idea of Newtonian absolute space
• 1898 – Henri Poincaré states that simultaneity is relative
• 1899 – Hendrik Antoon Lorentz published Lorentz transformations
• 1904 – Henri Poincaré presents the principle of relativity for electromagnetism
• 1905 – Albert Einstein completes his theory of special relativity and states the law of mass-energy conservation: \( E=mc^2 \)
• 1907 – Albert Einstein introduces the principle of equivalence of gravitation and inertia and uses it to predict the gravitational redshift
• 1915 – Albert Einstein completes his theory of general relativity. The new theory explains Mercury's strange motions that baffled Urbain Le Verrier.
• 1915 – Karl Schwarzschild publishes the Schwarzschild metric about a month after Einstein published his general theory of relativity. This was the first solution to the Einstein field equations other than the trivial flat space solution.
• 1916 – Albert Einstein shows that the field equations of general relativity admit wavelike solutions
• 1918 – J. Lense and Hans Thirring find the gravitomagnetic precession of gyroscopes in the equations of general relativity
• 1919 – Arthur Eddington leads a solar eclipse expedition which claims to detect gravitational deflection of light by the Sun
• 1921 – Theodor Kaluza demonstrates that a five-dimensional version of Einstein's equations unifies gravitation and electromagnetism
• 1937 – Fritz Zwicky states that galaxies could act as gravitational lenses
• 1937 – Albert Einstein, Leopold Infeld, and Banesh Hoffmann show that the geodesic equations of general relativity can be deduced from its field equations
• 1956 – John Lighton Synge publishes the first relativity text emphasizing spacetime diagrams and geometrical methods,
• 1957 – Felix A. E. Pirani uses Petrov classification to understand gravitational radiation,
• 1957 – Richard Feynman introduces sticky bead argument,
• 1957 – John Wheeler discusses the breakdown of classical general relativity near singularities and the need for quantum gravity
• 1959 – Pound–Rebka experiment, first precision test of gravitational redshift,
• 1959 – Lluis Bel introduces Bel–Robinson tensor and the Bel decomposition of the Riemann tensor,
• 1959 – Arthur Komar introduces the Komar mass,
• 1959 – Richard Arnowitt, Stanley Deser and Charles W. Misner developed ADM formalism.
• 1960 – Martin Kruskal and George Szekeres independently introduce the Kruskal–Szekeres coordinates for the Schwarzschild vacuum,
• 1960 – Shapiro effect confirmed,
• 1960 – Thomas Matthews and Allan R. Sandage associate 3C 48 with a point-like optical image, show radio source can be at most 15 light minutes in diameter,
• 1960 – Carl H. Brans and Robert H. Dicke introduce Brans–Dicke theory, the first viable alternative theory with a clear physical motivation,
• 1960 – Ivor M. Robinson and Andrzej Trautman discover the Robinson-Trautman null dust solution[1]
• 1961 – Pascual Jordan and Jürgen Ehlers develop the kinematic decomposition of a timelike congruence,
• 1960 – Robert Pound and Glen Rebka test the gravitational redshift predicted by the equivalence principle to approximately 1%
• 1962 – Roger Penrose and Ezra T. Newman introduce the Newman–Penrose formalism
• 1962 – Ehlers and Wolfgang Kundt classify the symmetries of Pp-wave spacetimes
• 1962: –Joshua Goldberg and Rainer K. Sachs prove the Goldberg–Sachs theorem
• 1962 – Ehlers introduces Ehlers transformations, a new solution generating method
• 1962 – Cornelius Lanczos introduces the Lanczos potential for the Weyl tensor
• 1962 – Richard Arnowitt, Stanley Deser, and Charles W. Misner introduce the ADM reformulation and global hyperbolicity
• 1962 – Yvonne Choquet-Bruhat on Cauchy problem and global hyperbolicity
• 1962 – Istvan Ozsvath and Engibert Schücking rediscover the circularly polarized monochromomatic gravitational wave
• 1962 – Hans Adolph Buchdahl discovers Buchdahl's theorem
• 1962 – Hermann Bondi introduces Bondi mass
• 1962 – Robert Dicke, Peter Roll, and R. Krotkov use a torsion fiber balance to test the weak equivalence principle to 2 parts in 100 billion
• 1963 – Roy Kerr discovers the Kerr vacuum solution of Einstein's field equations,
• 1963 – Redshifts of 3C 273 and other quasars show they are very distant; hence very luminous,
• 1963 – Newman, T. Unti and L.A. Tamburino introduce the NUT vacuum solution,
• 1963 – Roger Penrose introduces Penrose diagrams and Penrose limits,
• 1963 – First Texas Symposium on Relativistic Astrophysics held in Dallas, 16–18 December,
• 1964 – R. W. Sharp and Misner introduce the Misner–Sharp mass,
• 1964 – M. A. Melvin discovers the Melvin electrovacuum solution (aka the Melvin magnetic universe)
• 1964 – Irwin Shapiro predicts a gravitational time delay of radiation travel as a test of general relativity
• 1965 – Roger Penrose proves first of the singularity theorems
• 1965 – Newman and others discover the Kerr–Newman electrovacuum solution
• 1965 – Penrose discovers the structure of the light cones in gravitational plane wave spacetimes
• 1965 – Kerr and Alfred Schild introduce Kerr-Schild spacetime
• 1965 – Subrahmanyan Chandrasekhar determines a stability criterion
• 1965 – Arno Penzias and Robert Wilson discover the cosmic microwave background radiation
• 1965 – Joseph Weber puts the first Weber bar gravitational wave detector into operation
• 1966 – Sachs and Ronald Kantowski discover the Kantowski-Sachs dust solution,
• 1967 – Jocelyn Bell and Antony Hewish discover pulsars,
• 1967 – Robert H. Boyer and R. W. Lindquist introduce Boyer–Lindquist coordinates for the Kerr vacuum
• 1967 – Bryce DeWitt publishes on canonical quantum gravity
• 1967 – Werner Israel proves the no-hair theorem
• 1967 – Kenneth Nordtvedt develops PPN formalism
• 1967 – Mendel Sachs publishes factorization of Einstein's field equations
• 1967 – Hans Stephani discovers the Stephani dust solution
• 1968 – F. J. Ernst discovers the Ernst equation,
• 1968 – B. Kent Harrison discovers the Harrison transformation, a solution-generating method
• 1968 – Brandon Carter solves the geodesic equations for Kerr–Newmann electrovacuum
• 1968 – Hugo D. Wahlquist discovers the Wahlquist fluid
• 1968 – Irwin Shapiro presents the first detection of the Shapiro delay
• 1968 – Kenneth Nordtvedt studies a possible violation of the weak equivalence principle for self-gravitating bodies and proposes a new test of the weak equivalence principle based on observing the relative motion of the Earth and Moon in the Sun's gravitational field
• 1969 – William B. Bonnor introduces the Bonnor beam
• 1969 – Joseph Weber reports observation of gravitational waves
• 1969 – Penrose proposes the (weak) cosmic censorship hypothesis and the Penrose process
• 1969 – Stephen W. Hawking proves area theorem for black holes
1969 – Misner introduces the mixmaster universe
1970 – Frank J. Zerilli derives the Zerilli equation
1970 – Vladimir A. Belinskii, Isaak Markovich Khalatnikov, and Evgeny Lifshitz introduce the BKL conjecture
1970 – Chandrasekhar pushes on to 5/2 post-Newtonian order
1970 – Hawking and Penrose prove trapped surfaces must arise in black holes
1970 – the Kinnersley-Walker photon rocket
1970 – Peter Szekeres introduces colliding plane waves
1970 – Peter C. Aichelburg and Roman U. Sexl introduce the Aichelburg–Sexl ultraboost
1970 – Chandrasekhar pushes on to 5/2 post-Newtonian order
1971 – Introduction of the Khan–Penrose vacuum, a simple explicit colliding plane wave spacetime
1971 – Robert H. Gowdy introduces the Gowdy vacuum solutions (cosmological models containing circulating gravitational waves),
1971 – Cygnus X-1, the first solid black hole candidate, discovered by Uhuru satellite,
1971 – William H. Press discovers black hole ringing by numerical simulation,
1971 – Harrison and Estabrook algorithm for solving systems of PDEs
1971 – James W. York introduces conformal method generating initial data for ADM initial value formulation
1971 – Robert Geroch introduces Geroch group and a solution generating method
1972 – Jacob Bekenstein proposes that black holes have a non-decreasing entropy which can be identified with the area
1972 – Carter, Hawking and James M. Bardeen propose the four laws of black hole mechanics
1972 – Sachs introduces optical scalars and proves peeling theorem
1972 – Rainer Weiss proposes concept of interferometric gravitational wave detector
1972 – J. C. Hafele and R. E. Keating perform Hafele–Keating experiment
1972 – Richard H. Price studies gravitational collapse with numerical simulations
1972 – Saul Teukolsky derives the Teukolsky equation
1972 – Yakov B. Zel'dovich predicts the transmutation of electromagnetic and gravitational radiation
1973 – Publication by Charles W. Misner, Kip S. Thorne and John A. Wheeler of the treatise Gravitation, the first modern textbook on general relativity
1973 – Publication by Stephen W. Hawking and George Ellis of the monograph The Large Scale Structure of Space-Time
1973 – Geroch introduces the GHP formalism
1974 – Russell Hulse and Joseph Hooton Taylor, Jr. discover the Hulse–Taylor binary pulsar
1974 – James W. York and Niall Ó Murchadha present the analysis of the initial value formulation and examine the stability of its solutions
1974 – R. O. Hansen introduces Hansen–Geroch multipole moments
1974: –Tullio Regge introduces the Regge calculus
1974 – Hawking discovers Hawking radiation
1975 – Chandrasekhar and Steven Detweiler compute quasinormal modes
1975 – Szekeres and D. A. Szafron discover the Szekeres–Szafron dust solutions
1976 – Penrose introduces Penrose limits (every null geodesic in a Lorentzian spacetime behaves like a plane wave)
1976 – Gravity Probe A experiment confirmed slowing the flow of time caused by gravity matching the predicted effects to an accuracy of about 70 parts per million.
1976 – Robert Vessot and Martin Levine use a hydrogen maser clock on a Scout D rocket to test the gravitational redshift predicted by the equivalence principle to approximately 0.007%
1978 – Penrose introduces the notion of a thunderbolt,
1978 – Belinskii and Zakharov show how to solve Einstein's field equations using the inverse scattering transform; the first gravitational solitons,
1979 – Richard Schoen and Shing-Tung Yau prove the positive mass theorem.
1979 – Dennis Walsh, Robert Carswell, and Ray Weymann discover the gravitationally lensed quasar Q0957+561
1982 – Joseph Taylor and Joel Weisberg show that the rate of energy loss from the binary pulsar PSR B1913+16 agrees with that predicted by the general relativistic quadrupole formula to within 5%
2015 – Advanced LIGO reports the first direct detections of gravitational waves (GW150914 and GW151226).
2017 – Advanced LIGO and Fermi Gamma-ray Space Telescope constrain the speed of gravity to 1 part in 10 to the power of 15 of the speed of light with GW170817.
Timeline of knowledge about the interstellar and intergalactic medium

- 1848 — Lord Rosse studies M1 and names it the Crab Nebula. The telescope is much larger than the small refractors typical of this period and it also reveals the spiral nature of M51.
- 1864 — William Huggins studies the spectrum of the Orion Nebula and shows that it is a cloud of gas
- 1904 — Interstellar calcium detected on spectrograph at Potsdam
- 1909 — Slipher confirms Kaptyn’s theory of interstellar gas
- 1912 — Slipher confirms interstellar dust
- 1927 — Ira Bowen explains unidentified spectral lines from space as forbidden transition lines
- 1930 — Robert Trumpler discovers absorption by interstellar dust by comparing the angular sizes and brightnesses of globular clusters
- 1944 — Hendrik van de Hulst predicts the 21 cm hyperfine line of neutral interstellar hydrogen
- 1951 — Harold I. Ewen and Edward Purcell observe the 21 cm hyperfine line of neutral interstellar hydrogen
- 1956 — Lyman Spitzer predicts coronal gas around the Milky Way
- 1965 — James Gunn and Bruce Peterson use observations of the relatively low absorption of the blue component of the Lyman-alpha line from 3C9 to strongly constrain the density and ionization state of the intergalactic medium
- 1969 — Lewis Snyder, David Buhl, Ben Zuckerman, and Patrick Palmer find interstellar formaldehyde
- 1970 — Arno Penzias and Robert Wilson find interstellar carbon monoxide
- 1970 — George Carruthers observes molecular hydrogen in space
- 1977 — Christopher McKee and Jeremiah Ostriker propose a three component theory of the interstellar medium
- 1990 — Foreground "contamination" data from the COBE spacecraft provides the first all-sky map of the ISM in microwave bands.

Timeline of cosmic microwave background astronomy

- 1896 — Charles Édouard Guillaume estimates the "radiation of the stars" to be 5–6K.
- 1926 — Sir Arthur Eddington estimates the non-thermal radiation of starlight in the galaxy "... by the formula \( E = \sigma T^4 \) the effective temperature corresponding to this density is 3.18° absolute ... black body"
- 1930s — Cosmologist Erich Regener calculates that the non-thermal spectrum of cosmic rays in the galaxy has an effective temperature of 2.8 K
• 1931 – Term microwave first used in print: "When trials with wavelengths as low as 18 cm. were made known, there was undisguised surprise+that the problem of the micro-wave had been solved so soon." Telegraph & Telephone Journal XVII. 179/1

• 1934 – Richard Tolman shows that black-body radiation in an expanding universe cools but remains thermal

• 1938 – Nobel Prize winner (1920) Walther Nernst reestimates the cosmic ray temperature as 0.75K

• 1946 – Robert Dicke predicts "... radiation from cosmic matter" at <20 K, but did not refer to background radiation

• 1946 – George Gamow calculates a temperature of 50 K (assuming a 3-billion year old universe), commenting it "... is in reasonable agreement with the actual temperature of interstellar space", but does not mention background radiation.

• 1953 – Erwin Finlay-Freundlich in support of his tired light theory, derives a blackbody temperature for intergalactic space of 2.3K with comment from Max Born suggesting radio astronomy as the arbitrator between expanding and infinite cosmologies.

• 1941 – Andrew McKellar detected the cosmic microwave background as the coldest component of the interstellar medium by using the excitation of CN doublet lines measured by W. S. Adams in a B star, finding an "effective temperature of space" (the average bolometric temperature) of 2.3 K

• 1946 – George Gamow calculates a temperature of 50 K (assuming a 3-billion year old universe), commenting it "... is in reasonable agreement with the actual temperature of interstellar space", but does not mention background radiation.

• 1948 – Ralph Alpher and Robert Herman estimate "the temperature in the universe" at 5 K. Although they do not specifically mention microwave background radiation, it may be inferred.

• 1949 – Ralph Alpher and Robert Herman re-re-estimate the temperature at 28 K.

• 1953 – George Gamow estimates 7 K.

• 1956 – George Gamow estimates 6 K.

• 1955 – Émile Le Roux of the Nançay Radio Observatory, in a sky survey at $\lambda = 33$ cm, reported a near-isotropic background radiation of 3 kelvins, plus or minus 2.

• 1957 – Tigran Shmaonov reports that "the absolute effective temperature of the radioemission background ... is 4±3 K". It is noted that the "measurements showed that radiation intensity was independent of either time or direction of observation ... it is now clear that Shmaonov did observe the cosmic microwave background at a wavelength of 3.2 cm"

• 1960s – Robert Dicke re-estimates a microwave background radiation temperature of 40 K
1964 – A. G. Doroshkevich and Igor Dmitrievich Novikov publish a brief paper suggesting microwave searches for the black-body radiation predicted by Gamow, Alpher, and Herman, where they name the CMB radiation phenomenon as detectable.


1966 – Rainer K. Sachs and Arthur M. Wolfe theoretically predict microwave background fluctuation amplitudes created by gravitational potential variations between observers and the last scattering surface

1968 – Martin Rees and Dennis Sciama theoretically predict microwave background fluctuation amplitudes created by photons traversing time-dependent potential wells

1969 – R. A. Sunyaev and Yakov Zel'dovich study the inverse Compton scattering of microwave background photons by hot electrons

1983 – Researchers from the Cambridge Radio Astronomy Group and the Owens Valley Radio Observatory first detect the Sunyaev-Zel'dovich effect from clusters of galaxies

1983 – RELIKT-1 Soviet CMB anisotropy experiment was launched.

1990 – FIRAS on the Cosmic Background Explorer (COBE) satellite measures the black body form of the CMB spectrum with exquisite precision, and shows that the microwave background has a nearly perfect black-body spectrum and thereby strongly constrains the density of the intergalactic medium.

January 1992 – Scientists that analysed data from the RELIKT-1 report the discovery of anisotropy in the cosmic microwave background at the Moscow astrophysical seminar.

1992 – Scientists that analysed data from COBE DMR report the discovery of anisotropy in the cosmic microwave background.

1995 – The Cosmic Anisotropy Telescope performs the first high resolution observations of the cosmic microwave background.

1999 – First measurements of acoustic oscillations in the CMB anisotropy angular power spectrum from the TOCO, BOOMERANG, and Maxima Experiments. The BOOMERanG experiment makes higher quality maps at intermediate resolution, and confirms that the universe is "flat".

2002 – Polarization discovered by DASI.

2003 – E-mode polarization spectrum obtained by the CBI. The CBI and the Very Small Array produces yet higher quality maps at high resolution (covering small areas of the sky).

2003 – The Wilkinson Microwave Anisotropy Probe spacecraft produces an even higher quality map at low and intermediate resolution of the whole sky (WMAP provides no high-resolution data, but improves on the intermediate resolution maps from BOOMERanG).

2004 – E-mode polarization spectrum obtained by the CBI.
2004 – The Arcminute Cosmology Bolometer Array Receiver produces a higher quality map of the high resolution structure not mapped by WMAP.

2005 – The Arcminute Microkelvin Imager and the Sunyaev-Zel'dovich Array begin the first surveys for very high redshift clusters of galaxies using the Sunyaev-Zel'dovich effect.

2005 – Ralph A. Alpher is awarded the National Medal of Science for his groundbreaking work in nucleosynthesis and prediction that the universe expansion leaves behind background radiation, thus providing a model for the Big Bang theory.

2006 – The long-awaited three-year WMAP results are released, confirming previous analysis, correcting several points, and including polarization data.

2006 – Two of COBE’s principal investigators, George Smoot and John Mather, received the Nobel Prize in Physics in 2006 for their work on precision measurement of the CMBR.

2006–2011 – Improved measurements from WMAP, new supernova surveys ESSENCE and SNLS, and baryon acoustic oscillations from SDSS and WiggleZ, continue to be consistent with the standard Lambda-CDM model.

2010 – The first all-sky map from the Planck telescope is released.

2013 – An improved all-sky map from the Planck telescope is released, improving the measurements of WMAP and extending them to much smaller scales.

2014 – On March 17, 2014, astrophysicists of the BICEP2 collaboration announced the detection of inflationary gravitational waves in the B-mode power spectrum, which if confirmed, would provide clear experimental evidence for the theory of inflation. However, on 19 June 2014, lowered confidence in confirming the cosmic inflation findings was reported.

2015 – On January 30, 2015, the same team of astronomers from BICEP2 withdrew the claim made on the previous year. Based on the combined data of BICEP2 and Planck, the European Space Agency announced that the signal can be entirely attributed to dust in the Milky Way.

2018 – The final data and maps from the Planck telescope is released, with improved measurements of the polarization on large scales.

2019 – Planck telescope analyses of their final 2018 data continue to be released.

**Timeline of stellar astronomy**

- 2300 BC — First great period of star naming in China.
- 134 BC — Hipparchus creates the magnitude scale of stellar apparent luminosities.
- 185 AD — Chinese astronomers become the first to observe a supernova, the SN 185
- 964 — Abd al-Rahman al-Sufi (Azophi) writes the Book of Fixed Stars, in which he makes the first recorded observations of the Andromeda Galaxy and the Large Magellanic Cloud, and lists numerous stars with their positions, magnitudes, brightness, and colour, and gives drawings for each constellation
- 1000s (decade) — The Persian astronomer, Abū Rayhān al-Bīrūnī, describes the Milky Way galaxy as a collection of numerous nebulous stars
- 1006 — Ali ibn Ridwan and Chinese astronomers observe the SN 1006, the brightest stellar event ever recorded
- 1054 — Chinese and Arab astronomers observe the SN 1054, responsible for the creation of the Crab Nebula, the only nebula whose creation was observed
- 1181 — Chinese astronomers observe the SN 1181 supernova
- 1580 — Taqi al-Din measures the right ascension of the stars at the Constantinople Observatory of Taqi al-Din using an "observational clock" he invented and which he described as "a mechanical clock with three dials which show the hours, the minutes, and the seconds"
- 1596 — David Fabricius notices that Mira's brightness varies
- 1672 — Geminiano Montanari notices that Algol's brightness varies
- 1686 — Gottfried Kirch notices that Chi Cygni's brightness varies
- 1718 — Edmund Halley discovers stellar proper motions by comparing his astrometric measurements with those of the Greeks
- 1782 — John Goodricke notices that the brightness variations of Algol are periodic and proposes that it is partially eclipsed by a body moving around it
- 1784 — Edward Pigott discovers the first Cepheid variable star
- 1838 — Thomas Henderson, Friedrich Struve, and Friedrich Bessel measure stellar parallaxes
- 1844 — Friedrich Bessel explains the wobbling motions of Sirius and Procyon by suggesting that these stars have dark companions
- 1906 — Arthur Eddington begins his statistical study of stellar motions
- 1908 — Henrietta Leavitt discovers the Cepheid period-luminosity relation
- 1910 — Ejnar Hertzsprung and Henry Norris Russell study the relation between magnitudes and spectral types of stars
- 1924 — Arthur Eddington develops the main sequence mass-luminosity relationship
- 1929 — George Gamow proposes hydrogen fusion as the energy source for stars
- 1938 — Hans Bethe and Carl von Weizsäcker detail the proton-proton chain and CNO cycle in stars
- 1939 — Rupert Wildt realizes the importance of the negative hydrogen ion for stellar opacity
• 1952 — Walter Baade distinguishes between Cepheid I and Cepheid II variable stars
• 1953 — Fred Hoyle predicts a carbon-12 resonance to allow stellar triple alpha reactions at reasonable stellar interior temperatures
• 1961 — Chūshirō Hayashi publishes his work on the Hayashi track of fully convective stars
• 1963 — Fred Hoyle and William A. Fowler conceive the idea of supermassive stars
• 1964 — Subrahmanyan Chandrasekhar and Richard Feynman develop a general relativistic theory of stellar pulsations and show that supermassive stars are subject to a general relativistic instability
• 1967 — Eric Becklin and Gerry Neugebauer discover the Becklin-Neugebauer Object at 10 micrometres
• 1977 — (May 25) The Star Wars film is released and became a worldwide phenomenon, boosting interests in stellar systems.
• 2012 — (May 2) First visual proof of existence of black-holes. Suvi Gezari’s team in Johns Hopkins University, using the Hawaiian telescope Pan-STARRS 1, publish images of a supermassive black hole 2.7 million light-years away swallowing a red giant.

Timeline of astronomy

• 3114 BC: Mayan astronomers discover an 18.6-year cycle in the rising and setting of the Moon. From this they created the first almanacs – tables of the movements of the Sun, Moon and planets for the use in astrology. In 6th century BC Greece, this knowledge is used to predict eclipses.
• 585 BC: Thales of Miletus predicts a solar eclipse.
• 467 BC: Anaxagoras produced a correct explanation for eclipses and then described the Sun as a fiery mass larger than the Peloponnes, as well as attempting to explain rainbows and meteors. He was the first to explain that the Moon shines due to reflected light from the Sun.
• 400 BC: Around this date, Babylonians use the zodiac to divide the heavens into twelve equal segments of thirty degrees each, the better to record and communicate information about the position of celestial bodies.
• 387 BC: Plato, a Greek philosopher, founds a school (the Platonic Academy) that will influence the next 2000 years. It promotes the idea that everything in the universe moves in harmony and that the Sun, Moon, and planets move around Earth in perfect circles.
• 270 BC: Aristarchus of Samos proposes heliocentrism as an alternative to the Earth-centered universe. His heliocentric model places the Sun at its center, with Earth as just one planet orbiting it. However, there were only a few people who took the theory seriously.
• 240 BC: The earliest recorded sighting of Halley's Comet is made by Chinese astronomers. Their records of the comet's movement allow astronomers today to predict accurately how the comet's orbit changes over the centuries.
- **6 BC**: The Magi - probably Persian astronomers/astrologers (Astrology) - observed a planetary conjunction on Saturday (Sabbath) April 17, 6 BC that signified the birth of a great Hebrew king: Jesus.

- **4 BC**: The astronomer Shi Shen is believed to have cataloged 809 stars in 122 constellations, and he also made the earliest known observation of sunspots.

- **140**: Ptolemy publishes his star catalogue, listing 48 constellations and endorses the geocentric (Earth-centered) view of the universe. His views go unquestioned for nearly 1500 years in Europe, and are passed down to Arabic and medieval European astronomers in his book the Almagest.

- **400**: The Hindu cosmological time cycles explained in the Surya Siddhanta, give the average length of the sidereal year (the length of the Earth's revolution around the Sun) as 365.2563627 days, which is only 1.4 seconds longer than the modern value of 365.256363004 days. This remains the most accurate estimate for the length of the sidereal year anywhere in the world for over a thousand years.

- **499**: Indian mathematician-astronomer Aryabhata, in his Aryabhatiya first identifies the force gravity to explain why objects do not fall when the Earth rotates, propounds a geocentric Solar System of gravitation, and an eccentric elliptical model of the planets, where the planets spin on their axis and follow elliptical orbits, the Sun and the Moon revolve around the Earth in epicycles. He also writes that the planets and the Moon do not have their own light but reflect the light of the Sun, and that the Earth rotates on its axis causing day and night and also that the Sun rotates around the Earth causing years.

- **628**: Indian mathematician-astronomer Brahmagupta, in his Brahma-Sphuta-Siddhanta, first recognizes gravity as a force of attraction, and briefly describes the second law of Newton's law of universal gravitation. He gives methods for calculations of the motions and places of various planets, their rising and setting, conjunctions, and calculations of the solar and lunar eclipses.

- **773**: The Sanskrit works of Aryabhata and Brahmagupta, along with the Sanskrit text Surya Siddhanta, are translated into Arabic, introducing Arabic astronomers to Indian astronomy.

- **777**: Muhammad al-Fazari and Ya’qūb ibn Ṭāriq translate the Surya Siddhanta and Brahmasphutasiddhanta, and compile them as the Zij al-Sindhind, the first Zij treatise.

- **830**: The first major Arabic work of astronomy is the Zij al-Sindh by al-Khwarizimi. The work contains tables for the movements of the Sun, the Moon, and the five planets known at the time. The work is significant as it introduced Ptolemaic concepts into Islamic sciences. This work also marks the turning point in Arabic astronomy. Hitherto, Arabic astronomers had adopted a primarily research approach to the field, translating works of others and learning already discovered knowledge. Al-Khwarizmi's work marked the beginning of nontraditional methods of study and calculations.

- **850**: al-Farghani wrote Kitab fi Jawani ("A compendium of the science of stars"). The book primarily gave a summary of Ptolemaic cosmography. However, it also corrected Ptolemy based on findings of earlier Arab astronomers. Al-Farghani gave revised values for the obliquity of the ecliptic, the precessional
movement of the apogees of the Sun and the Moon, and the circumference of the Earth. The books were widely circulated through the Muslim world, and even translated into Latin.

- **928**: The earliest surviving astrolabe is constructed by Islamic mathematician–astronomer Mohammad al-Fazari. Astrolabes are the most advanced instruments of their time. The precise measurement of the positions of stars and planets allows Islamic astronomers to compile the most detailed almanacs and star atlases yet.

- **1030**: Abū Rayḥān al-Bīrūnī discussed the Indian heliocentric theories of Aryabhata, Brahmagupta and Varāhamihira in his Ta'rikh al-Hind (Indica in Latin). Biruni stated that the followers of Aryabhata consider the Earth to be at the center. In fact, Biruni casually stated that this does not create any mathematical problems.

- **1031**: Abu Said Sinjari, a contemporary of Abu Rayhan Biruni, suggested the possible heliocentric movement of the Earth around the Sun.

- **1054**: Chinese astronomers record the sudden appearance of a bright star. Native-American rock carvings also show the brilliant star close to the Moon. This star is the Crab supernova exploding.

- **1070**: Abu Ubayd al-Juzjani published the Tarik al-Aflak. In his work, he indicated the so-called "equant" problem of the Ptolemy model. Al-Juzjani even proposed a solution for the problem. In al-Andalus, the anonymous work al-Ístidrak ala Batlamyus (meaning "Recapitulation regarding Ptolemy"), included a list of objections to the Ptolemy astronomy. One of the most important works in this period was Al-Shuku ala Batlamyus ("Doubts on Ptolemy"). In this, the author summed up the inconsistencies of the Ptolemy models. Many astronomers took up the challenge posed in this work, namely to develop alternate models that evaded such errors.

- **1126**: Islamic and Indian astronomical works (including Aryabhatiya and Brahma-Sphuta-Siddhanta) are translated into Latin in Córdoba, Spain in 1126, introducing European astronomers to Islamic and Indian astronomy.

- **1150**: Indian mathematician-astronomer Bhāskara II, in his Siddhanta Shiromani, calculates the longitudes and latitudes of the planets, lunar and solar eclipses, risings and settings, the Moon's lunar crescent, syzygies, and conjunctions of the planets with each other and with the fixed stars, and explains the three problems of diurnal rotation. He also calculates the planetary mean motion, ellipses, first visibilities of the planets, the lunar crescent, the seasons, and the length of the Earth's revolution around the Sun to 9 decimal places.

- **1250**: Mo'ayyeduddin Urdi develops the Urdi lemma, which is later used in the Copernican heliocentric model. Nasir al-Din al-Tusi resolved significant problems in the Ptolemaic system by developing the Tusi-couple as an alternative to the physically problematic equant introduced by Ptolemy. His Tusi-couple is later used in the Copernican model. Tusi's student Qutb al-Din al-Shirazi, in his The Limit of Accomplishment concerning Knowledge of the Heavens, discusses the possibility of
heliocentrism. Najm al-Din al-Qazwini al-Katibi, who also worked at the Maraghah observatory, in his Hikmat al-'Ain, wrote an argument for a heliocentric model, though he later abandoned the idea.

- **1350**: Ibn al-Shatir (1304–1375), in his A Final Inquiry Concerning the Rectification of Planetary Theory, eliminated the need for an equant by introducing an extra epicycle, departing from the Ptolemaic system in a way very similar to what Copernicus later also did. Ibn al-Shatir proposed a system that was only approximately geocentric, rather than exactly so, having demonstrated trigonometrically that the Earth was not the exact center of the universe. His rectification is later used in the Copernican model.

- **1543**: Nicolaus Copernicus publishes De revolutionibus orbium coelestium containing his theory that Earth travels around the Sun. However, he complicates his theory by retaining Plato's perfect circular orbits of the planets.

- **1572**: A brilliant supernova (SN 1572 - thought, at the time, to be a comet) is observed by Tycho Brahe, who proves that it is traveling beyond Earth's atmosphere and therefore provides the first evidence that the heavens can change.

- **1608**: Dutch eyeglass maker Hans Lippershey tries to patent a refracting telescope (the first historical record of one). The invention spreads rapidly across Europe, as scientists make their own instruments. Their discoveries begin a revolution in astronomy.

- **1609**: Johannes Kepler publishes his New Astronomy. In this and later works, he announces his three laws of planetary motion, replacing the circular orbits of Plato with elliptical ones. Almanacs based on his laws prove to be highly accurate.

- **1610**: Galileo Galilei publishes Sidereus Nuncius describing the findings of his observations with the telescope he built. These include spots on the Sun, craters on the Moon, and four satellites of Jupiter. Proving that not everything orbits Earth, he promotes the Copernican view of a Sun-centered universe.

- **1655**: As the power and the quality of the telescopes increase, Christiaan Huygens studies Saturn and discovers its largest satellite, Titan. He also explains Saturn's appearance, suggesting the planet is surrounded by a thin ring.

- **1663**: Scottish astronomer James Gregory describes his "gregorian" reflecting telescope, using parabolic mirrors instead of lenses to reduce chromatic aberration and spherical aberration, but is unable to build one.

- **1668**: Isaac Newton builds the first reflecting telescope, his Newtonian telescope.

- **1687**: Isaac Newton publishes his first copy of the book Philosophiae Naturalis Principia Mathematica, establishing the theory of gravitation and laws of motion. The Principia explains Kepler's laws of planetary motion and allows astronomers to understand the forces acting between the Sun, the planets, and their moons.

- **1705**: Edmond Halley calculates that the comets recorded at 76-year intervals from 1456 to 1682 are one and the same. He predicts that the comet will return again in 1758. When it reappears as expected, the comet is named in his honor.
• 1750: French astronomer Nicolas de Lacaille sails to southern oceans and begins work compiling a catalog of more than 10000 stars in the southern sky. Although Halley and others have observed from the Southern Hemisphere before, Lacaille's star catalog is the first comprehensive one of the southern sky.

• 1781: Amateur astronomer William Herschel discovers the planet Uranus, although he at first mistakes it for a comet. Uranus is the first planet to be discovered beyond Saturn, which was thought to be the most distant planet in ancient times.

• 1784: Charles Messier publishes his catalog of star clusters and nebulas. Messier draws up the list to prevent these objects from being identified as comets. However, it soon becomes a standard reference for the study of star clusters and nebulae and is still in use today.

• 1800: William Herschel splits sunlight through a prism and with a thermometer, measures the energy given out by different colours. He notices a sudden increase in energy beyond the red end of the spectrum, discovering invisible infrared and laying the foundations of spectroscopy.

• 1801: Italian astronomer Giuseppe Piazzi discovers what appears to be a new planet orbiting between Mars and Jupiter, and names it Ceres. William Herschel proves it is a very small object, calculating it to be only 320 km in diameter, and not a planet. He proposes the name asteroid, and soon other similar bodies are being found. We now know that Ceres is 932 km in diameter, and is now considered to be a dwarf planet.

• 1814: Joseph von Fraunhofer builds the first accurate spectrometer and uses it to study the spectrum of the Sun's light. He discovers and maps hundreds of fine dark lines crossing the solar spectrum. In 1859 these lines are linked to chemical elements in the Sun's atmosphere. Spectroscopy becomes a method for studying what stars are made of.

• 1838: Friedrich Bessel successfully uses the method of stellar parallax, the effect of Earth's annual movement around the Sun, to calculate the distance to 61 Cygni, the first star other than the Sun to have its distance from Earth measured. Bessel's is a truly accurate measurement of stellar positions, and the parallax technique establishes a framework for measuring the scale of the universe.

• 1843: German amateur astronomer Heinrich Schwabe, who has been studying the Sun for the past 17 years, announces his discovery of a regular cycle in sunspot numbers - the first clue to the Sun's internal structure.

• 1845: Irish astronomer William Parsons, 3rd Earl of Rosse completes the first of the world's great telescopes, with a 180-cm mirror. He uses it to study and draw the structure of nebulae, and within a few months discovers the spiral structure of the Whirlpool Galaxy. French physicists Jean Foucault and Armand Fizeau take the first detailed photographs of the Sun's surface through a telescope - the birth of scientific astrophotography. Within five years, astronomers produce the first detailed photographs of the Moon. Early film is not sensitive enough to image stars.

• 1846: A new planet, Neptune, is identified by German astronomer Johann Gottfried Galle while searching in the position suggested by Urbain Le Verrier. Le Verrier has calculated the position and size of the planet
from the effects of its gravitational pull on the orbit of Uranus. An English mathematician, John Couch Adams, also made a similar calculation a year earlier.

- **1868**: Astronomers notice a new bright emission line in the spectrum of the Sun's atmosphere during an eclipse. The emission line is caused by an element's giving out light, and British astronomer Norman Lockyer concludes that it is an element unknown on Earth. He calls it helium, from the Greek word for the Sun. Nearly 30 years later, helium is found on Earth.

- **1872**: An American astronomer Henry Draper takes the first photograph of the spectrum of a star (Vega), showing absorption lines that reveal its chemical makeup. Astronomers begin to see that spectroscopy is the key to understanding how stars evolve. William Huggins uses absorption lines to measure the redshifts of stars, which give the first indication of how fast stars are moving.

- **1895**: Konstantin Tsiolkovsky publishes his first article on the possibility of space flight. His greatest discovery is that a rocket, unlike other forms of propulsion, will work in a vacuum. He also outlines the principle of a multistage launch vehicle.

- **1901**: A comprehensive survey of stars, the Henry Draper Catalogue, is published. In the catalog, Annie Jump Cannon proposes a sequence of classifying stars by the absorption lines in their spectra, which is still in use today.

- **1806**: Ejnar Hertzsprung establishes the standard for measuring the true brightness of a star. He shows that there is a relationship between color and absolute magnitude for 90% of the stars in the Milky Way Galaxy. In 1913, Henry Norris Russell publishes a diagram that shows this relationship. Although astronomers agree that the diagram shows the sequence in which stars evolve, they argue about which way the sequence progresses. Arthur Eddington finally settles the controversy in 1924.

- **1910**: Williamina Fleming publishes her discovery of white dwarf stars.

- **1912**: Henrietta Swan Leavitt discovers the period-luminosity relation for Cepheid variables, whereas the brightness of a star is proportional to its luminosity oscillation period. It opened a whole new branch of possibilities of measuring distances on the universe, and this discovery was the basis for the work done by Edwin Hubble on extragalactic astronomy.

- **1916**: German physicist Karl Schwarzschild uses Albert Einstein's theory of general relativity to lay the groundwork for black hole theory. He suggests that if any star collapse to a certain size or smaller, its gravity will be so strong that no form of radiation will escape from it.

- **1923**: Edwin Hubble discovers a Cepheid variable star in the "Andromeda Nebula" and proves that Andromeda and other nebulae are galaxies far beyond our own. By 1925, he produces a classification system for galaxies.

- **1925**: Cecilia Payne-Gaposchkin discovers that hydrogen is the most abundant element in the Sun's atmosphere, and accordingly, the most abundant element in the universe by relating the spectral classes of stars to their actual temperatures and by applying the ionization theory developed by Indian
physicist Meghnad Saha. This opens the path for the study of stellar atmospheres and chemical abundances, contributing to understand the chemical evolution of the universe.

- **1926:** Robert Goddard launches the first rocket powered by liquid fuel. He also demonstrates that a rocket can work in a vacuum. His later rockets break the sound barrier for the first time.

- **1929:** Edwin Hubble discovered that the universe is expanding and that the farther away a galaxy is, the faster it is moving away from us. Two years later, Georges Lemaître suggests that the expansion can be traced to an initial "**Big Bang**".

- **1930:** By applying new ideas from subatomic physics, Subrahmanyan Chandrasekhar predicts that the atoms in a white dwarf star of more than 1.44 solar masses will disintegrate, causing the star to collapse violently. In 1933, Walter Baade and Fritz Zwicky describe the neutron star that results from this collapse, causing a supernova explosion. Clyde Tombaugh discovers the dwarf planet Pluto at the Lowell Observatory in Flagstaff, Arizona. The object is so faint and moving so slowly that he has to compare photos taken several nights apart.

- **1932:** Karl Jansky detects the first radio waves coming from space. In 1942, radio waves from the Sun are detected. Seven years later radio astronomers identify the first distant source - the Crab Nebula, and the galaxies Centaurus A and M87.

- **1938:** German physicist Hans Bethe explains how stars generate energy. He outlines a series of nuclear fusion reactions that turn hydrogen into helium and release enormous amounts of energy in a star's core. These reactions use the star's hydrogen very slowly, allowing it to burn for billions of years.

- **1944:** A team of German scientists led by Wernher von Braun develops the V-2, the first rocket-powered ballistic missile. Scientists and engineers from Braun's team were captured at the end of **World War II** and drafted into the American and Russian rocket programs.

- **1948:** The largest telescope in the world, with a 5.08m (200 in) mirror, is completed at Palomar Mountain in California. At the time, the telescope pushes single-mirror telescope technology to its limits - large mirrors tend to bend under their own weight.

- **1957:** Russia launches the first artificial satellite, Sputnik 1, into orbit, beginning the space age. The US launches its first satellite, Explorer 1, four months later.

- **1958:** (July 29) Beginning of the NASA (National Aeronautics and Space Administration), agency newly created by the United States to catch up with Soviet space technologies. It absorbs all research centers and staffs of the NACA (National Advisory Committee for Aeronautics), an organization founded in 1915.

- **1959:** Russia and the US both launch probes to the Moon, but NASA's Pioneer probes all failed. The Russian Luna program was more successful. Luna 2 crash-lands on the Moon's surface in September, and Luna 3 returns the first pictures of the Moon's farside in October.

- **1960:** Cornell University astronomer Frank Drake performed the first modern SETI experiment, named "**Project Ozma**", after the Queen of Oz in L. Frank Baum's fantasy books.
• **1961**: Russia takes the lead in the space race as Yuri Gagarin becomes the first person to orbit Earth in April. NASA astronaut Alan Shepard becomes the first American in space a month later, but does not go into orbit, although he is the first person to land with himself still inside his spacecraft thus technically achieving the first complete human spaceflight by FAI definitions. John Glenn achieves orbit in early 1962.

• **1962**: Mariner 2 becomes the first probe to reach another planet, flying past Venus in December. NASA follows this with the successful Mariner 4 mission to Mars in 1965, both the US and Russia send many more probes to planets through the rest of the 1960s and 1970s.

• **1963**: Dutch-American astronomer Maarten Schmidt measures the spectra of quasars, the mysterious star-like radio sources discovered in 1960. He establishes that quasars are active galaxies, and among the most distant objects in the universe.

• **1965**: Arno Penzias and Robert Wilson announce the discovery of a weak radio signal coming from all parts of the sky. Scientists figure out that this must be emitted by an object at a temperature of −270 °C. Soon it is recognized as the remnant of the very hot radiation from the Big Bang that created the universe 13 billion years ago, see Cosmic microwave background. This radio signal is emitted by the electron in hydrogen flipping from pointing up or down and is approximated to happen once in a million years for every particle. Hydrogen is present in interstellar space gas throughout the entire universe and most dense in nebulae which is where the signals originate. Even though the electron of hydrogen only flips once every million years the mere quantity of hydrogen in space gas makes the presence of these radio waves prominent.

• **1966**: Russian Luna 9 probe makes the first successful soft landing on the Moon in January, while the US lands the far more complex Surveyor missions, which follows up to NASA's Ranger series of crash-landers, scout sites for possible manned landings.

• **1967**: Jocelyn Bell Burnell and Antony Hewish detected the first pulsar, an object emitting regular pulses of radio waves. Pulsars are eventually recognized as rapidly spinning neutron stars with intense magnetic fields - the remains of a supernova explosion.

• **1968**: NASA's Apollo 8 mission becomes the first human spaceflight mission to enter the gravitational influence of another celestial body and to orbit it.

• **1969**: The US wins the race for the Moon, as Neil Armstrong and Buzz Aldrin step onto the lunar surface on July 20. Apollo 11 is followed by five further landing missions, three carrying a sophisticated Lunar Roving Vehicle.

• **1970**: The Uhuru satellite, designed to map the sky at X-ray wavelengths, is launched by NASA. The existence of X-rays from the Sun and a few other stars has already been found using rocket-launched experiments, but Uhuru charts more than 300 X-ray sources, including several possible black holes.
• **1971:** Russia launches its first space station, Salyut 1, into orbit. It is followed by a series of stations, culminating with Mir in 1986. A permanent platform in orbit allows cosmonauts to carry out serious research and to set a series of new duration records for spaceflight.

• **1972:** Charles Thomas Bolton was the first astronomer to present irrefutable evidence of the existence of a black hole.

• **1975:** The Russian probe Venera 9 lands on the surface of Venus and sends back the first picture of its surface. The first probe to land on another planet, Venera 7 in 1970, had no camera. Both break down within an hour in the hostile atmosphere.

• **1976:** Two NASA probes arrive at Mars. Each Viking mission consists of an orbiter, which photographs the planet from above, and a lander, which touches down on the surface, analyzes the rocks, and searches unsuccessfully for life.

• **1977:** On August 20 the Voyager 2 space probe launched by NASA to study the Jovian system, Saturnian system, Uranian system, Neptunian system, the Kuiper belt, the heliosphere and the interstellar space. On September 5 the Voyager 1 space probe launched by NASA to study the Jovian system, Saturnian system and the interstellar medium.

• **1981:** Space Shuttle Columbia, the first of NASA's reusable Space Shuttles, makes its maiden flight, ten years in development, the Shuttle will make space travel routine and eventually open the path for a new International Space Station.

• **1983:** The first infrared astronomy satellite, IRAS, is launched. It must be cooled to extremely low temperatures with liquid helium, and it operates for only 300 days before the supply of helium is exhausted. During this time it completes an infrared survey of 98% of the sky.

• **1986:** NASA's spaceflight program comes to a halt when Space Shuttle Challenger explodes shortly after launch. A thorough inquiry and modifications to the rest of the fleet kept the shuttles on the ground for nearly three years. The returning Halley's Comet is met by a fleet of five probes from Russia, Japan, and Europe. The most ambitious is the European Space Agency's Giotta spacecraft, which flies through the comet's coma and photographs the nucleus.

• **1990:** The Magellan probe, launched by NASA, arrives at Venus and spends three years mapping the planet with radar. Magellan is the first in a new wave of probes that include Galileo, which arrives at Jupiter in 1995, and Cassini which arrives at Saturn in 2004. The Hubble Space Telescope, the first large optical telescope in orbit, is launched using the Space Shuttle, but astronomers soon discovered that it is crippled by a problem with its mirror. A complex repair mission in 1993 allows the telescope to start producing spectacular images of distant stars, nebulae, and galaxies.

• **1992:** The Cosmic Background Explorer satellite produces a detailed map of the background radiation remaining from the Big Bang. The map shows "ripples", caused by slight variations in the density of the early universe – the seeds of galaxies and galaxy clusters. The 10-meter Keck telescope on Mauna Kea,
Hawaii, is completed. The first revolutionary new wave of telescopes, the Keck's main mirror is made of 36 six-sided segments, with computers to control their alignment. New optical telescopes also make use of interferometry – improving resolution by combining images from separate telescopes.

- **1995:** The first exoplanet, 51 Pegasi b, is discovered by Michel Mayor and Didier Queloz.
- **1998:** Construction work on a huge new space station named ISS has begun. A joint venture between many countries, including former space rivals Russia and the US.
- **2005:** Mike Brown and his team discovered a large body in the outer Solar System. It was temporarily named as (2003) UB313. Initially, it appeared larger than Pluto, and was called the tenth planet.
- **2006:** International Astronomical Union (IAU) adopted a new definition of planet. A new distinct class of objects called dwarf planets was also decided. Pluto was redefined as a dwarf planet along with Ceres and Eris, formerly known as (2003) UB313. Eris was named after the IAU General Assembly in 2006.
- **2008:** 2008 TC3 becomes the first Earth-impacting meteoroid spotted and tracked prior to impact.
- **2012:** (May 2) First visual proof of existence of black holes is published. Suvi Gezari’s team in Johns Hopkins University, using the Hawaiian telescope Pan-STARRS 1, record images of a supermassive black hole 2.7 million light-years away that is swallowing a red giant.
- **2013:** In October 2013, the first extrasolar asteroid is detected around white dwarf star GD 61. It is also the first detected extrasolar body which contains water in liquid or solid form.
- **2015:** On July 14, with the successful encounter of Pluto by NASA’s New Horizons spacecraft, the United States became the first nation to explore all of the nine major planets recognized in 1981. Later on September 14, LIGO was the first to directly detect gravitational waves.
- **2016:** Exoplanet Proxima Centauri b is discovered around Proxima Centauri by the European Southern Observatory, making it the closest known exoplanet to the Solar System as of 2016.
- **2017:** In August 2017, a neutron star collision that occurred in the galaxy NGC 4993 produced the gravitational wave signal GW170817, which was observed by the LIGO/Virgo collaboration. After 1.7 seconds, it was observed as the gamma-ray burst GRB 170817A by the Fermi Gamma-ray Space Telescope and INTEGRAL, and its optical counterpart SSS17a was detected 11 hours later at the Las Campanas Observatory. Further optical observations e.g. by the Hubble Space Telescope and the Dark Energy Camera, ultraviolet observations by the Swift Gamma-Ray Burst Mission, X-ray observations by the Chandra X-ray Observatory and radio observations by the Karl G. Jansky Very Large Array complemented the detection. This was the first instance of a gravitational wave event that was observed to have a simultaneous electromagnetic signal, thereby marking a significant breakthrough for multi-messenger astronomy. Non-observation of neutrinos is attributed to the jets being strongly off-axis.
- **2019:** China’s Chang’e 4 became the first spacecraft to perform a soft landing on the lunar far side. In April 2019, the Event Horizon Telescope Collaboration obtained the first image of a black hole which was at the
center of galaxy M87, providing more evidence for the existence of supermassive black holes in accordance with general relativity. India launched its second lunar probe called Chandrayaan 2 with an orbiter that was successful and a lander called Vikram along with a rover called Pragyan which failed just 2.1 km above the lunar south pole.

- **2020:** NASA proposes to launch Mars 2020 to Mars with a brand new Mars rover.

**Timeline of algorithms**

- Before – writing about "recipes" (on cooking, rituals, agriculture and other sorts of themes like willa & Mayan)
- c. 1700–2000 BC – Egyptians develop earliest known algorithms for multiplying two numbers
- c. 1600 BC – Babylonians develop earliest known algorithms for factorization and finding square roots
- c. 300 BC – Euclid's algorithm
- c. 200 BC – the Sieve of Eratosthenes
- 263 AD – Gaussian elimination described by Liu Hui
- 628 – Chakravala method described by Brahmagupta
- c. 820 – Al-Khawarizmi described algorithms for solving linear equations and quadratic equations in his Algebra; the word algorithm comes from his name
- 825 – Al-Khawarizmi described the algorism, algorithms for using the Hindu-Arabic numeral system, in his treatise On the Calculation with Hindu Numerals, which was translated into Latin as Algoritmi de numero Indorum, where "Algoritmi", the translator's rendition of the author's name gave rise to the word algorithm (Latin algorithmus) with a meaning "calculation method"
- c. 850 – cryptanalysis and frequency analysis algorithms developed by Al-Kindi (Alkindus) in A Manuscript on Deciphering Cryptographic Messages, which contains algorithms on breaking encryptions and ciphers
- c. 1025 – Ibn al-Haytham (Alhazen), was the first mathematician to derive the formula for the sum of the fourth powers, and in turn, he develops an algorithm for determining the general formula for the sum of any integral powers, which was fundamental to the development of integral calculus
- c. 1400 – Ahmad al-Qalqashandi gives a list of ciphers in his Subh al-a'sha which include both substitution and transposition, and for the first time, a cipher with multiple substitutions for each plaintext letter; he also gives an exposition on and worked example of cryptanalysis, including the use of tables of letter frequencies and sets of letters which can not occur together in one word
- 1540 – Lodovico Ferrari discovered a method to find the roots of a quartic polynomial
• 1545 – Gerolamo Cardano published Cardano's method for finding the roots of a cubic polynomial
• 1614 – John Napier develops method for performing calculations using logarithms
• 1671 – Newton–Raphson method developed by Isaac Newton
• 1690 – Newton–Raphson method independently developed by Joseph Raphson
• 1706 – John Machin develops a quickly converging inverse-tangent series for π and computes π to 100 decimal places
• 1789 – Jurij Vega improves Machin's formula and computes π to 140 decimal places,
• 1805 – FFT-like algorithm known by Carl Friedrich Gauss
• 1842 – Ada Lovelace writes the first algorithm for a computing engine
• 1903 – A Fast Fourier Transform algorithm presented by Carle David Tolmé Runge
• 1926 – Borůvka's algorithm
• 1926 – Primary decomposition algorithm presented by Grete Hermann
• 1934 – Delaunay triangulation developed by Boris Delaunay
• 1936 – Turing machine, an abstract machine developed by Alan Turing, with others developed the modern notion of algorithm.
• 1942 – A Fast Fourier Transform algorithm developed by G.C. Danielson and Cornelius Lanczos
• 1945 – Merge sort developed by John von Neumann
• 1947 – Simplex algorithm developed by George Dantzig
• 1952 – Huffman coding developed by David A. Huffman
• 1953 – Simulated annealing introduced by Nicholas Metropolis
• 1954 – Radix sort computer algorithm developed by Harold H. Seward
• 1956 – Kruskal's algorithm developed by Joseph Kruskal
• 1957 – Prim's algorithm developed by Robert Prim
• 1959 – Dijkstra's algorithm developed by Edsger Dijkstra
• 1959 – Shell sort developed by Donald L. Shell
• 1959 – De Casteljau's algorithm developed by Paul de Casteljau
• 1959 – QR factorization algorithm developed independently by John G.F. Francis and Vera Kublanovskaya
• 1960 – Karatsuba multiplication
• 1962 – AVL trees
• 1962 – Quicksort developed by C. A. R. Hoare
• 1962 – Ford–Fulkerson algorithm developed by L. R. Ford, Jr. and D. R. Fulkerson
• 1962 – Bresenham's line algorithm developed by Jack E. Bresenham
• 1962 – Gale–Shapley 'stable-marriage' algorithm developed by David Gale and Lloyd Shapley
• 1964 – Heapsort developed by J. W. J. Williams
• 1964 – multigrid methods first proposed by R. P. Fedorenko
• 1965 – Cooley–Tukey algorithm rediscovered by James Cooley and John Tukey
• 1965 – Levenshtein distance developed by Vladimir Levenshtein
• 1965 – Cocke–Younger–Kasami (CYK) algorithm independently developed by Tadao Kasami
• 1965 – Buchberger's algorithm for computing Gröbner bases developed by Bruno Buchberger
• 1966 – Dantzig algorithm for shortest path in a graph with negative edges
• 1967 – Viterbi algorithm proposed by Andrew Viterbi
• 1967 – Cocke–Younger–Kasami (CYK) algorithm independently developed by Daniel H. Younger
• 1968 – A* graph search algorithm described by Peter Hart, Nils Nilsson, and Bertram Raphael
• 1968 – Risch algorithm for indefinite integration developed by Robert Henry Risch
• 1969 – Strassen algorithm for matrix multiplication developed by Volker Strassen
• 1970 – Dinic's algorithm for computing maximum flow in a flow network by Yefim (Chaim) A. Dinitz
• 1970 – Knuth–Bendix completion algorithm developed by Donald Knuth and Peter B. Bendix
• 1970 – BFGS method of the quasi-Newton class
• 1972 – Graham scan developed by Ronald Graham
• 1972 – Red–black trees and B-trees discovered
• 1973 – RSA encryption algorithm discovered by Clifford Cocks
• 1973 – Jarvis march algorithm developed by R. A. Jarvis
• 1973 – Hopcroft–Karp algorithm developed by John Hopcroft and Richard Karp
• 1974 – Pollard's p − 1 algorithm developed by John Pollard
• 1975 – Genetic algorithms popularized by John Holland
• 1975 – Pollard's rho algorithm developed by John Pollard
• 1975 – Aho–Corasick string matching algorithm developed by Alfred V. Aho and Margaret J. Corasick
• 1975 – Cylindrical algebraic decomposition developed by George E. Collins
• 1976 – Salamin–Brent algorithm independently discovered by Eugene Salamin and Richard Brent
• 1976 – Knuth–Morris–Pratt algorithm developed by Donald Knuth and Vaughan Pratt and independently by J. H. Morris
• 1977 – Boyer–Moore string search algorithm for searching the occurrence of a string into another string.
• 1977 – RSA encryption algorithm rediscovered by Ron Rivest, Adi Shamir, and Len Adleman
• 1977 – LZ77 algorithm developed by Abraham Lempel and Jacob Ziv
• 1977 – multigrid methods developed independently by Achi Brandt and Wolfgang Hackbusch
• 1978 – LZ78 algorithm developed from LZ77 by Abraham Lempel and Jacob Ziv
• 1978 – Bruun's algorithm proposed for powers of two by Georg Bruun
• 1979 – Khachiyan's ellipsoid method developed by Leonid Khachiyan
• 1979 – ID3 decision tree algorithm developed by Ross Quinlan
• 1980 – Brent's Algorithm for cycle detection Richard P. Brendt
• 1981 – Quadratic sieve developed by Carl Pomerance
• 1983 – Simulated annealing developed by S. Kirkpatrick, C. D. Gelatt and M. P. Vecchi
• 1983 – Classification and regression tree (CART) algorithm developed by Leo Breiman, et al.
• 1984 – LZW algorithm developed from LZ78 by Terry Welch
• 1984 – Karmarkar's interior-point algorithm developed by Narendra Karmarkar
• 1984 - ACORN_PRNG discovered by Roy Wikramaratna and used privately
• 1985 – Simulated annealing independently developed by V. Cerny
• 1985 - Car–Parrinello molecular dynamics developed by Roberto Car and Michele Parrinello
• 1985 – Splay trees discovered by Sleator and Tarjan
• 1986 – Blum Blum Shub proposed by L. Blum, M. Blum, and M. Shub
• 1986 – Push relabel maximum flow algorithm by Andrew Goldberg and Robert Tarjan
• 1987 – Fast multipole method developed by Leslie Greengard and Vladimir Rokhlin
• 1988 – Special number field sieve developed by John Pollard
• 1989 - ACORN_PRNG published by Roy Wikramaratna
• 1990 – General number field sieve developed from SNFS by Carl Pomerance, Joe Buhler, Hendrik Lenstra, and Leonard Adleman
• 1991 – Wait-free synchronization developed by Maurice Herlihy
• 1992 – Deutsch–Jozsa algorithm proposed by D. Deutsch and Richard Jozsa
• 1992 – C4.5 algorithm, a descendant of ID3 decision tree algorithm, was developed by Ross Quinlan
• 1993 – Apriori algorithm developed by Rakesh Agrawal and Ramakrishnan Srikant
• 1993 – Karger's algorithm to compute the minimum cut of a connected graph by David Karger
• 1994 – Shor's algorithm developed by Peter Shor
Timeline of information theory

- 1872 – Ludwig Boltzmann presents his H-theorem, and with it the formula for the entropy of a single gas particle
- 1878 – J. Willard Gibbs defines the Gibbs entropy: the probabilities in the entropy formula are now taken as probabilities of the state of the whole system
- 1924 – Harry Nyquist discusses quantifying "intelligence" and the speed at which it can be transmitted by a communication system
• 1927 – John von Neumann defines the von Neumann entropy, extending the Gibbs entropy to quantum mechanics
• 1928 – Ralph Hartley introduces Hartley information as the logarithm of the number of possible messages, with information being communicated when the receiver can distinguish one sequence of symbols from any other (regardless of any associated meaning)
• 1929 – Leó Szilárd analyses Maxwell’s Demon, showing how a Szilard engine can sometimes transform information into the extraction of useful work
• 1940 – Alan Turing introduces the deciban as a measure of information inferred about the German Enigma machine cypher settings by the Banburismus process
• 1944 – Claude Shannon’s theory of information is substantially complete
• 1947 – Richard W. Hamming invents Hamming codes for error detection and correction (to protect patent rights, the result is not published until 1950)
• 1948 – Claude E. Shannon publishes A Mathematical Theory of Communication
• 1949 – Claude E. Shannon’s Communication Theory of Secrecy Systems is declassified
• 1949 – Leon G. Kraft discovers Kraft’s inequality, which shows the limits of prefix codes
• 1949 – Marcel J. E. Golay introduces Golay codes for forward error correction
• 1951 – Solomon Kullback and Richard Leibler introduce the Kullback–Leibler divergence
• 1951 – David A. Huffman invents Huffman encoding, a method of finding optimal prefix codes for lossless data compression
• 1953 – August Albert Sardinas and George W. Patterson devise the Sardinas–Patterson algorithm, a procedure to decide whether a given variable-length code is uniquely decodable
• 1954 – Irving S. Reed and David E. Muller propose Reed–Muller codes
• 1955 – Peter Elias introduces convolutional codes
• 1957 – Eugene Prange first discusses cyclic codes
• 1959 – Alexis Hocquenghem, and independently the next year Raj Chandra Bose and Dwijendra Kumar Ray-Chaudhuri, discover BCH codes
• 1960 – Irving S. Reed and Gustave Solomon propose Reed–Solomon codes
• 1962 – Robert G. Gallager proposes low-density parity-check codes; they are unused for 30 years due to technical limitations
1965 – Dave Forney discusses concatenated codes
1966 – Fumitada Itakura (Nagoya University) and Shuzo Saito (Nippon Telegraph and Telephone) develop linear predictive coding (LPC), a form of speech coding
1967 – Andrew Viterbi reveals the Viterbi algorithm, making decoding of convolutional codes practicable
1968 – Elwyn Berlekamp invents the Berlekamp–Massey algorithm; its application to decoding BCH and Reed–Solomon codes is pointed out by James L. Massey the following year
1968 – Chris Wallace and David M. Boulton publish the first of many papers on Minimum Message Length (MML) statistical and inductive inference
1970 – Valerii Denisovich Goppa introduces Goppa codes
1972 – Jørn Justesen proposes Justesen codes, an improvement of Reed–Solomon codes
1972 – Nasir Ahmed proposes the discrete cosine transform (DCT), which he develops with T. Natarajan and K. R. Rao in 1973; the DCT later became the most widely used lossy compression algorithm, the basis for multimedia formats such as JPEG, MPEG and MP3
1973 – David Slepian and Jack Wolf discover and prove the Slepian–Wolf coding limits for distributed source coding
1976 – Gottfried Ungerboeck gives the first paper on trellis modulation; a more detailed exposition in 1982 leads to a raising of analogue modem POTS speeds from 9.6 kbit/s to 33.6 kbit/s
1976 – Richard Pasco and Jorma J. Rissanen develop effective arithmetic coding techniques
1977 – Abraham Lempel and Jacob Ziv develop Lempel–Ziv compression (LZ77)
1989 – Phil Katz publishes the .zip format including DEFLATE (LZ77 + Huffman coding); later to become the most widely used archive container
1993 – Claude Berrou, Alain Glavieux and Punya Thitimajshima introduce Turbo codes
1994 – Michael Burrows and David Wheeler publish the Burrows–Wheeler transform, later to find use in bzip2
1995 – Benjamin Schumacher coins the term qubit and proves the quantum noiseless coding theorem
2006 – first Asymmetric numeral systems entropy coding: since 2014 popular replacement of Huffman and arithmetic coding in compressors like Facebook Zstandard or Apple LZFSE
2008 – Erdal Arikan introduces polar codes, the first practical construction of codes that achieves capacity for a wide array of channels

Timeline of probability and statistics
• 8th century - Forms of probability and statistics were developed by Al-Khalil, an Arab mathematician studying cryptology. He wrote the Book of Cryptographic Messages which contains the first use of permutations and combinations to list all possible Arabic words with and without vowels.

• 9th century - Al-Kindi was the first to use statistics to decipher encrypted messages and developed the first code breaking algorithm in the House of Wisdom in Baghdad, based on frequency analysis. He wrote a book entitled Manuscript on Deciphering Cryptographic Messages, containing detailed discussions on statistics. This text laid the foundations for statistics and cryptanalysis. Al-Kindi also made the earliest known use of statistical inference, while he and other Arab cryptologists developed the early statistical methods for decoding encrypted messages.

• 13th century - An important contribution of Ibn Adlan was on sample size for use of frequency analysis.

• 1560s (published 1663) – Cardano's Liber de ludo aleae attempts to calculate probabilities of dice throws. He demonstrates the efficacy of defining odds as the ratio of favourable to unfavourable outcomes (which implies that the probability of an event is given by the ratio of favourable outcomes to the total number of possible outcomes).

• 1577 – Bartolomé de Medina defends probabilism, the view that in ethics one may follow a probable opinion even if the opposite is more probable

• 1654 – Pascal and Fermat create the mathematical theory of probability,

• 1657 – Huygens's De ratiociniis in ludo aleae is the first book on mathematical probability,

• 1662 – Graunt's Natural and Political Observations Made upon the Bills of Mortality makes inferences from statistical data on deaths in London,

• 1666 - In Le Journal des Scavans xxxi, August 2, 1666 (359-370(=364)) appears a review of the third edition (1665) of John Graunt's Observations on the Bills of Mortality. This review gives a summary of 'plusieurs reflexions curieuses', of which the second are Graunt's data on life expectancy. This review is used by Nicolaus Bernoulli in his De Usu Artis Conjectandi in Jure (1709).

• 1669 - Christiaan Huygens and his brother Lodewijk discuss between August and December that year Graunts mortality table (Graunt 1662, p. 62) in letters #1755

• 1693 – Halley prepares the first mortality tables statistically relating death rate to age

• 1710 – Arbuthnot argues that the constancy of the ratio of male to female births is a sign of divine providence

• 1713 – Posthumous publication of Jacob Bernoulli's Ars Conjectandi, containing the first derivation of a law of large numbers

• 1724 – Abraham de Moivre studies mortality statistics and the foundation of the theory of annuities in Annuities upon Lives
• 1733 – Abraham de Moivre introduces the normal distribution to approximate the binomial distribution in probability
• 1739 – Hume's Treatise of Human Nature argues that inductive reasoning is unjustified
• 1761 – Thomas Bayes proves Bayes' theorem
• 1786 – Playfair's Commercial and Political Atlas introduces graphs and bar charts of data
• 1801 – Gauss predicts the orbit of Ceres using a line of best fit
• 1805 – Adrien-Marie Legendre introduces the method of least squares for fitting a curve to a given set of observations,
• 1814 – Laplace's Essai philosophique sur les probabilités defends a definition of probabilities in terms of equally possible cases, introduces generating functions and Laplace transforms, uses conjugate priors for exponential families, proves an early version of the Bernstein–von Mises theorem on the asymptotic irrelevance of prior distributions on the limiting posterior distribution and the role of the Fisher information on asymptotically normal posterior modes.
• 1835 – Quetelet's Treatise on Man introduces social science statistics and the concept of the "average man"
• 1866 – Venn's Logic of Chance defends the frequency interpretation of probability.
• 1877–1883 – Charles Sanders Peirce outlines frequentist statistics, emphasizing the use of objective randomization in experiments and in sampling. Peirce also invented an optimally designed experiment for regression.
• 1880 – Thiele gives a mathematical analysis of Brownian motion, introduces the likelihood function, and invents cumulants.
• 1888 – Galton introduces the concept of correlation
• 1900 – Bachelier analyzes stock price movements as a stochastic process,
• 1908 – Student's t-distribution for the mean of small samples published in English (following earlier derivations in German).
• 1921 – Keynes' Treatise on Probability defends a logical interpretation of probability. Wright develops path analysis.
• 1928 – Tippett and Fisher introduce extreme value theory
• 1933 – Andrey Nikolaevich Kolmogorov publishes his book Basic notions of the calculus of probability (Grundbegriffe der Wahrscheinlichkeitsrechnung) which contains an axiomatization of probability based on measure theory
• 1935 – R. A. Fisher's Design of Experiments (1st ed)
• 1937 – Neyman introduces the concept of confidence interval in statistical testing
1946 – Cox's theorem derives the axioms of probability from simple logical assumptions
1948 – Shannon's Mathematical Theory of Communication defines capacity of communication channels in terms of probabilities
1953 – Nicholas Metropolis introduces the idea of thermodynamic simulated annealing methods

Timeline of classical mechanics

- 4th century BC - Aristotle invents the system of Aristotelian physics, which is later largely disproved
- 4th century BC - Babylonian astronomers calculate Jupiter's position using the mean speed theorem
- 260 BC - Archimedes works out the principle of the lever and connects buoyancy to weight
- 60 - Hero of Alexandria writes Metrica, Mechanics (on means to lift heavy objects), and Pneumatics (on machines working on pressure)
- 350 - Themistius states, that static friction is larger than kinetic friction
- 6th century - John Philoponus says that by observation, two balls of very different weights will fall at nearly the same speed. He therefore tests the equivalence principle
- 1021 - Al-Biruni uses three orthogonal coordinates to describe point in space
- 1000-1030 - Alhazen and Avicenna develop the concepts of inertia and momentum
- 1100-1138 - Avempace develops the concept of a reaction force
- 1100-1165 - Hibat Allah Abu'l-Barakat al-Baghdaadi discovers that force is proportional to acceleration rather than speed, a fundamental law in classical mechanics
- 1121 - Al-Khazini publishes The Book of the Balance of Wisdom, in which he develops the concepts of gravity at-a-distance. He suggests that the gravity varies depending on its distance from the center of the universe, namely Earth
- 1340-1358 - Jean Buridan develops the theory of impetus
- 14th century - Oxford Calculators and French collaborators prove the mean speed theorem
- 14th century - Nicole Oresme derives the times-squared law for uniformly accelerated change. Oresme, however, regarded this discovery as a purely intellectual exercise having no relevance to the description of any natural phenomena, and consequently failed to recognise any connection with the motion of accelerating bodies
- 1500-1528 - Al-Birjandi develops the theory of "circular inertia" to explain Earth's rotation
- 16th century - Francesco Beato and Luca Ghini experimentally contradict aristotelian view on free fall.
- 16th century - Domingo de Soto suggests that bodies falling through a homogeneous medium are uniformly accelerated. Soto, however, did not anticipate many of the qualifications and refinements contained in
Galileo's theory of falling bodies. He did not, for instance, recognise, as Galileo did, that a body would fall with a strictly uniform acceleration only in a vacuum, and that it would otherwise eventually reach a uniform terminal velocity

- 1581 - Galileo Galilei notices the timekeeping property of the pendulum
- 1589 - Galileo Galilei uses balls rolling on inclined planes to show that different weights fall with the same acceleration
- 1638 - Galileo Galilei publishes Dialogues Concerning Two New Sciences (which were materials science and kinematics) where he develops, amongst other things, Galilean transformation
- 1645 - Ismaël Bullialdus argues that "gravity" weakens as the inverse square of the distance
- 1651 - Giovanni Battista Riccioli and Francesco Maria Grimaldi discover the Coriolis effect
- 1658 - Christiaan Huygens experimentally discovers that balls placed anywhere inside an inverted cycloid reach the lowest point of the cycloid in the same time and thereby experimentally shows that the cycloid is the tautochrone
- 1668 - John Wallis suggests the law of conservation of momentum
- 1676-1689 - Gottfried Leibniz develops the concept of vis viva, a limited theory of conservation of energy
- 1687 - Isaac Newton publishes his Philosophiae Naturalis Principia Mathematica, in which he formulates Newton's laws of motion and Newton's law of universal gravitation
- 1690 - James Bernoulli shows that the cycloid is the solution to the tautochrone problem
- 1691 - Johann Bernoulli shows that a chain freely suspended from two points will form a catenary
- 1691 - James Bernoulli shows that the catenary curve has the lowest center of gravity of any chain hung from two fixed points
- 1696 - Johann Bernoulli shows that the cycloid is the solution to the brachistochrone problem
- 1707 - Gottfried Leibniz probably develops the principle of least action
- 1710 - Jakob Hermann shows that Laplace–Runge–Lenz vector is conserved for a case of the inverse-square central force
- 1714 - Brook Taylor derives the fundamental frequency of a stretched vibrating string in terms of its tension and mass per unit length by solving an ordinary differential equation
- 1733 - Daniel Bernoulli derives the fundamental frequency and harmonics of a hanging chain by solving an ordinary differential equation
- 1734 - Daniel Bernoulli solves the ordinary differential equation for the vibrations of an elastic bar clamped at one end
- 1739 - Leonhard Euler solves the ordinary differential equation for a forced harmonic oscillator and notices the resonance
• 1742 - Colin Maclaurin discovers his uniformly rotating self-gravitating spheroids
• 1743 - Jean le Rond d'Alembert publishes his "Traité de Dynamique", in which he introduces the concept of generalized forces and D'Alembert's principle
• 1747 - d'Alembert and Alexis Clairaut publish first approximate solutions to the three-body problem
• 1749 - Leonhard Euler derives equation for Coriolis acceleration
• 1759 - Leonhard Euler solves the partial differential equation for the vibration of a rectangular drum
• 1764 - Leonhard Euler examines the partial differential equation for the vibration of a circular drum and finds one of the Bessel function solutions
• 1776 - John Smeaton publishes a paper on experiments relating power, work, momentum and kinetic energy, and supporting the conservation of energy
• 1788 - Joseph Louis Lagrange presents Lagrange's equations of motion in the Méchanique Analitique
• 1789 - Antoine Lavoisier states the law of conservation of mass
• 1803 - Louis Poinsot develops idea of angular momentum conservation (this result was previously known only in the case of conservation of areal velocity)
• 1813 - Peter Ewart supports the idea of the conservation of energy in his paper On the measure of moving force
• 1821 - William Hamilton begins his analysis of Hamilton's characteristic function and Hamilton–Jacobi equation
• 1829 - Carl Friedrich Gauss introduces Gauss's principle of least constraint
• 1834 - Carl Jacobi discovers his uniformly rotating self-gravitating ellipsoids
• 1834 - Louis Poinsot notes an instance of the intermediate axis theorem
• 1835 - William Hamilton states Hamilton's canonical equations of motion
• 1838 - Liouville begins work on Liouville's theorem
• 1841 - Julius Robert von Mayer, an amateur scientist, writes a paper on the conservation of energy but his lack of academic training leads to its rejection
• 1847 - Hermann von Helmholtz formally states the law of conservation of energy
• First half of XIX century - Cauchy develops his momentum equation and his stress tensor
• 1851 - Léon Foucault shows the Earth's rotation with a huge pendulum (Foucault pendulum)
• 1870 - Rudolf Clausius deduces virial theorem
• 1902 - James Jeans finds the length scale required for gravitational perturbations to grow in a static nearly homogeneous medium
• 1915 - Emmy Noether proves Noether's theorem, from which conservation laws are deduced
Timeline of particle discoveries

- **1800**: William Herschel discovers "heat rays"
- **1801**: Johann Wilhelm Ritter made the hallmark observation that invisible rays just beyond the violet end of the visible spectrum were especially effective at lightening silver chloride-soaked paper. He called them "oxidizing rays" to emphasize chemical reactivity and to distinguish them from "heat rays" at the other end of the invisible spectrum (both of which were later determined to be photons). The more general term "chemical rays" was adopted shortly thereafter to describe the oxidizing rays, and it remained popular throughout the 19th century. The terms chemical and heat rays were eventually dropped in favor of ultraviolet and infrared radiation, respectively.
- **1895**: Discovery of the ultraviolet radiation below 200 nm, named vacuum ultraviolet (later identified as photons) because it is strongly absorbed by air, by the German physicist Victor Schumann
- **1895**: X-ray produced by Wilhelm Röntgen (later identified as photons)
- **1897**: Electron discovered by J. J. Thomson
- **1899**: Alpha particle discovered by Ernest Rutherford in uranium radiation
- **1900**: Gamma ray (a high-energy photon) discovered by Paul Villard in uranium decay
- **1911**: Atomic nucleus identified by Ernest Rutherford, based on scattering observed by Hans Geiger and Ernest Marsden
- **1919**: Proton discovered by Ernest Rutherford
- **1931**: Deuteron discovered by Harold Urey (predicted by Rutherford in 1920)
- **1932**: Neutron discovered by James Chadwick (predicted by Rutherford in 1920)
- **1932**: Antielectron (or positron), the first antiparticle, discovered by Carl D. Anderson (proposed by Paul Dirac in 1927 and by Ettore Majorana in 1928)
- **1937**: Muon (or mu lepton) discovered by Seth Neddermeyer, Carl D. Anderson, J.C. Street, and E.C. Stevenson, using cloud chamber measurements of cosmic rays (it was mistaken for the pion until 1947)
- **1947**: Pion (or pi meson) discovered by C. F. Powell's group, including César Lattes (first author) and Giuseppe Occhialini (predicted by Hideki Yukawa in 1935)
- **1947**: Kaon (or K meson), the first strange particle, discovered by George Dixon Rochester and Clifford Charles Butler
- **1950**: Lambda baryon discovered during a study of cosmic-ray interactions
- **1955**: Antiproton discovered by Owen Chamberlain, Emilio Segrè, Clyde Wiegand, and Thomas Ypsilantis
- **1956**: Electron neutrino detected by Frederick Reines and Clyde Cowan (proposed by Wolfgang Pauli in 1930 to explain the apparent violation of conservation of energy in beta decay). At the time it was simply referred to as neutrino since there was only one known neutrino.
- **1962**: Muon neutrino (or mu neutrino) shown to be distinct from the electron neutrino by a group headed by Leon Lederman
- **1964**: Xi baryon discovery at Brookhaven National Laboratory
- **1969**: Partons (internal constituents of hadrons) observed in deep inelastic scattering experiments between protons and electrons at SLAC; this was eventually associated with the quark model (predicted by Murray Gell-Mann and George Zweig in 1964) and thus constitutes the discovery of the up quark, down quark, and strange quark.
- **1974**: J/ψ meson discovered by groups headed by Burton Richter and Samuel Ting, demonstrating the existence of the charm quark (proposed by James Bjorken and Sheldon Lee Glashow in 1964)
- **1975**: Tau discovered by a group headed by Martin Perl
- **1977**: Upsilon meson discovered at Fermilab, demonstrating the existence of the bottom quark (proposed by Kobayashi and Maskawa in 1973)
- **1979**: Gluon observed indirectly in three-jet events at DESY
- **1983**: W and Z bosons discovered by Carlo Rubbia, Simon van der Meer, and the CERN UA1 collaboration (predicted in detail by Sheldon Glashow, Mohammad Abdus Salam, and Steven Weinberg)
- **1995**: Top quark discovered at Fermilab
- **1995**: Antihydrogen produced and measured by the LEAR experiment at CERN
- **2000**: Tau neutrino first observed directly at Fermilab
- **2011**: Antihelium-4 produced and measured by the STAR detector; the first particle to be discovered by the experiment
- **2012**: A particle exhibiting most of the predicted characteristics of the Higgs boson discovered by researchers conducting the Compact Muon Solenoid and ATLAS experiments at CERN's Large Hadron Collider
Timeline of fundamental physics discoveries

- **250 BCE:** Archimedes' principle: Archimedes
- **500:** Theory of Impetus: John Philoponus
- **1514:** Heliocentrism: Nicholas Copernicus
- **1589:** Galileo's Leaning Tower of Pisa experiment: Galileo Galilei
- **1613:** Inertia: Galileo Galilei
- **1621:** Snell's law: Willebrord Snellius
- **1660:** Pascal's Principle: Blaise Pascal
- **1660:** Hooke's law: Robert Hooke
- **1676:** Rømer's determination of the speed of light traveling from the moons of Jupiter.
- **1687:** Laws of Motion and Law of Gravitation and calculus: Isaac Newton
- **1782:** Conservation of matter: Lavoisier
- **1785:** Inverse square law for electric charges confirmed: Charles-Augustin de Coulomb
- **1801:** Wave theory of light: Thomas Young
- **1803:** Atomic theory of matter: John Dalton
- **1806:** Kinetic energy: Thomas Young
- **1814:** Wave theory of light, interference: Fresnel
- **1820:** Evidence for electromagnetic interactions: André-Marie Ampère, Jean-Baptiste Biot, Félix Savart
- **1827:** Electrical resistance, etc.: Ohm
- **1831:** Electromagnetic induction: Michael Faraday
- **1838:** Lines of Force, Fields: Michael Faraday
- **1838:** Earth's magnetic field: Wilhelm Eduard Weber and Carl Friedrich Gauss
- **1843:** Conservation of energy: Julius Robert von Mayer, William Thomson, 1st Baron Kelvin
- **1845:** Faraday Rotation (light and electromagnetic): Michael Faraday
- **1847:** Conservation of energy 2: James Prescott Joule, Hermann von Helmholtz
- **1851:** Second law of thermodynamics: Rudolf Clausius, William Thomson, 1st Baron Kelvin
- **1859:** Kinetic theory: James Clerk Maxwell
- **1861:** Black body: Gustav Kirchhoff
- **1863:** Entropy: Rudolf Clausius
- **1864:** A Dynamical Theory of the Electromagnetic Field: James Clerk Maxwell
• 1867: Dynamic Theory of Gases, James Clerk Maxwell
• 1871–89: Statistical Mechanics: Ludwig Boltzmann, Josiah Willard Gibbs
• 1884: Boltzmann derives Stefan's radiation law
• 1887: Michelson–Morley experiment
• 1887: Electromagnetic Waves: Heinrich Rudolf Hertz
• 1893: Radiation Law: Wilhelm Wien
• 1895: X-Rays discovered: Wilhelm Röntgen
• 1896: Radioactivity: Henri Becquerel
• 1897: Electron discovered: J. J. Thomson
• 1900: Formula for Black-Body Radiation: Max Planck, Quantum Hypothesis: Max Planck
• 1905: Special Relativity: Albert Einstein, Photoelectric Effect: Albert Einstein, Brownian Motion: Albert Einstein
• 1911: Equivalence Principle: Albert Einstein, Discovery of the Atomic Nucleus: Ernest Rutherford, Superconductivity: Kamerlingh Onnes
• 1913: Bohr Model of the atom: Niels Bohr
• 1916: General Relativity: Albert Einstein
• 1923: Stern–Gerlach experiment, Matter waves: Louis de Broglie, Galaxies: Edwin Hubble
• 1925: Matrix Mechanics: Werner Heisenberg
• 1926: Schrödinger Equation: Erwin Schrödinger
• 1927: Big Bang: Georges Lemaître
• 1927: Uncertainty Principle: Werner Heisenberg
• 1928: Antimatter predicted: Paul Dirac
• 1929: Expansion of the Universe Confirmed: Edwin Hubble
• 1932: Antimatter discovered: Carl David Anderson, Neutron discovered: James Chadwick
• 1937: Muon discovered: Carl David Anderson & Seth Neddermeyer
• 1938: Superfluidity discovered: Pyotr Kapitsa, Nuclear Fission discovered: Otto Hahn
• 1947: Pion discovered: C.F. Powell, Giuseppe Occhialini, César Lattes
• 1948: Quantum Electrodynamics: Richard Feynman
• 1956: Electron neutrino discovered
• 1957: Parity violation discovered
• 1957: Theory of Superconductivity

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• **1962**: Theory of strong interactions, Muon neutrino discovered
• **1964**: Bell's Theorem initiates quantitative study of quantum entanglement
• **1967**: Theory of Weak interaction, Pulsars discovered
• **1974**: Charmed quark discovered
• **1975**: Tau lepton discovered
• **1977**: Bottom quark discovered
• **1980**: Quantum Hall effect discovered
• **1980**: Richard Feynman proposes quantum computing
• **1981**: Theory of cosmic inflation, Fractional quantum Hall effect discovered
• **1984**: W and Z bosons directly observed
• **1984**: First laboratory implementation of quantum cryptography
• **1993**: Quantum teleportation of unknown states proposed
• **1994**: Shor's algorithm discovered, initiating the serious study of quantum computation.
• **1995**: Top quark discovered
• **1995**: Bose-Einstein condensation observed
• **1998**: Accelerating universe discovered
• **1998**: Atmospheric neutrino oscillation established
• **2000**: Tau neutrino discovered
• **2012**: Higgs Boson discovered
• **2015**: Gravitational waves detected

**Timeline of microscope technology**

• c. 700 BCE — The "Nimrud lens" of Assyrians manufacture, a rock crystal disk with a convex shape believed to be a burning or magnifying lens.
• 167 BCE — The Chinese use simple microscopes made of a lens and a water-filled tube to visualize the unseen.
• 13th century — The increase in use of lenses in eyeglasses probably led to the wide spread use of simple microscopes (single lens magnifying glasses) with limited magnification.
• 1590 — earliest date of a claimed Hans Martens/Zacharias Janssen invention of the compound microscope (claim made in 1655).
• After 1609 — Galileo Galilei is described as being able to close focus his telescope to view small objects close up and/or looking through the wrong end in reverse to magnify small objects. A telescope used in this fashion is the same as a compound microscope but historians debate whether Galileo was magnifying small objects or viewing near by objects with his terrestrial telescope (convex objective/concave eyepiece) reversed.

• 1619 — Earliest recorded description of a compound microscope, Dutch Ambassador Willem Boreel sees one in London in the possession of Dutch inventor Cornelis Drebbel, an instrument about eighteen inches long, two inches in diameter, and supported on 3 brass dolphins.

• 1621 — Cornelis Drebbel presents, in London, a compound microscope with a convex objective and a convex eyepiece (a "Keplerian" microscope).

• c.1622 — Drebbel presents his invention in Rome.

• 1624 — Galileo improves on a compound microscope he sees in Rome and presents his occhiolino to Prince Federico Cesi, founder of the Accademia dei Lincei (in English, The Linceans).

• 1625 — Francesco Stelluti and Federico Cesi publish Apiarium, the first account of observations using a compound microscope.

• 1625 — Giovanni Faber of Bamberg (1574 - 1629) of the Linceans, after seeing Galileo's occhiolino, coins the word microscope by analogy with telescope.

• 1655 — In an investigation by Willem Boreel, Dutch spectacle-maker Johannes Zachariassen claims his father, Zacharias Janssen, invented the compound microscope in 1590. Zachariassen's claimed dates are so early it is sometimes assumed, for the claim to be true, that his grandfather, Hans Martens, must have invented it. Findings are published by writer Pierre Borel. Discrepancies in Boreel's investigation and Zachariassen's testimony (including misrepresenting his date of birth and role in the invention) has led some historians to consider this claim dubious.

• 1665 — Robert Hooke publishes Micrographia, a collection of biological micrographs. He coins the word cell for the structures he discovers in cork bark.

• 1674 — Antonie van Leeuwenhoek improves on a simple microscope for viewing biological specimens.

• 1825 — Joseph Jackson Lister develops combined lenses that cancelled spherical and chromatic aberration.

• 1846 — Carl Zeiss founded Carl Zeiss AG, to mass-produce microscopes and other optical instruments.

• 1850s — John Leonard Riddell, Professor of Chemistry at Tulane University, invents the first practical binocular microscope.

• 1863 — Henry Clifton Sorby develops a metallurgical microscope to observe structure of meteorites.

• 1860s — Ernst Abbe, a colleague of Carl Zeiss, discovers the Abbe sine condition, a breakthrough in microscope design, which until then was largely based on trial and error. The company of Carl Zeiss exploited this discovery and becomes the dominant microscope manufacturer of its era.
• 1928 — Edward Hutchinson Synge publishes theory underlying the near-field scanning optical microscope
• 1931 — Ernst Ruska starts to build the first electron microscope. It is a transmission electron microscope (TEM)
• 1936 — Erwin Wilhelm Müller invents the field emission microscope.
• 1938 — James Hillier builds another TEM
• 1951 — Erwin Wilhelm Müller invents the field ion microscope and is the first to see atoms.
• 1953 — Frits Zernike, professor of theoretical physics, receives the Nobel Prize in Physics for his invention of the phase-contrast microscope.
• 1955 — George Nomarski, professor of microscopy, published the theoretical basis of differential interference contrast microscopy.
• 1957 — Marvin Minsky, a professor at MIT, invents the confocal microscope, an optical imaging technique for increasing optical resolution and contrast of a micrograph by means of using a spatial pinhole to block out-of-focus light in image formation. This technology is a predecessor to today's widely used confocal laser scanning microscope.
• 1967 — Erwin Wilhelm Müller adds time-of-flight spectroscopy to the field ion microscope, making the first atom probe and allowing the chemical identification of each individual atom.
• 1981 — Gerd Binnig and Heinrich Rohrer develop the scanning tunneling microscope (STM).
• 1986 — Gerd Binnig, Quate, and Gerber invent the atomic force microscope (AFM)
• 1988 — Alfred Cerezo, Terence Godfrey, and George D. W. Smith applied a position-sensitive detector to the atom probe, making it able to resolve materials in 3-dimensions with near-atomic resolution.
• 1988 — Kingo Itaya invents the Electrochemical scanning tunneling microscope
• 1991 — Kelvin probe force microscope invented.

Timeline of telecommunication

• AD 26–37 – Roman Emperor Tiberius rules the empire from the island of Capri by signaling messages with metal mirrors to reflect the sun.
• 1520 – Ships on Ferdinand Magellan's voyage signal to each other by firing cannon and raising flags.
• 1792 – Claude Chappe establishes the first long-distance semaphore telegraph line.
• 1831 – Joseph Henry proposes and builds an electric telegraph.
• 1836 – Samuel Morse develops the Morse code.
• 1843 – Samuel Morse builds the first long distance electric telegraph line.
- 1876 – Alexander Graham Bell and Thomas A. Watson exhibit an electric telephone in Boston.
- 1889 – Almon Strowger patents the direct dial.
- 1877 – Thomas Edison patents the phonograph.
- 1920 – Radio station KDKA based in Pittsburgh began the first broadcast.
- 1925 – John Logie Baird transmits the first television signal.
- 1942 – Hedy Lamarr and George Antheil invent frequency hopping spread spectrum communication technique.
- 1947 – Full-scale commercial television is first broadcast.
- 1963 – First geosynchronous communications satellite is launched, 17.5 years after Arthur C. Clarke’s article.
- 1999 – Sirius satellite radio is introduced.
- 1926 – Commercial availability of the radiofax.
- 1964 – First modern fax machine commercially available (Long Distance Xerography).
- 1947 – Douglas H. Ring and W. Rae Young of Bell Labs propose a cell-based approach which led to "cellular phones."
- 1981 – Nordic Mobile Telephone, the world's first automatic mobile phone is put into operation.
- 1991 – GSM is put into operation.
- 1992 – Neil Papworth sends the first SMS (or text message).
- 1999 – 45% of Australians have a mobile phone.
- 1949 – Claude Elwood Shannon, the "father of information theory", mathematically proves the Nyquist–Shannon sampling theorem.
- 1965 – First email sent (at MIT).
- 1966 – Charles Kao realizes that silica-based optical waveguides offer a practical way to transmit light via total internal reflection.
- 1969 – The first hosts of ARPANET, Internet's ancestor, are connected.
- 1971 – Erna Schneider Hoover invent a computerized switching system for telephone traffic.
- 1971 – 8-inch floppy disk removable storage medium for computers is introduced.
- 1975 – "First list servers are introduced."
- 1976 – The personal computer (PC) market is born.
- 1977 – Donald Knuth begins work on TeX.
• 1983 – Microsoft Word software is launched.
• 1985 - AOL is launched.
• 1989 – Tim Berners-Lee and Robert Cailliau build the prototype system which became the World Wide Web at CERN.
• 1989 – WordPerfect 5.1 word processing software released.
• 1989 – Lotus Notes software is launched.
• 1991 – Anders Olsson transmits solitary waves through an optical fiber with a data rate of 32 billion bits per second.
• 1992 – Internet2 organization is created.
• 1992 – IBM ThinkPad 700C laptop computer created. It was lightweight compared to its predecessors.
• 1993 – Mosaic graphical web browser is launched.
• 1994 – Internet radio broadcasting is born.
• 1996 – Motorola StarTAC mobile phone introduced. It was significantly smaller than previous cellphones.
• 1997 – SixDegrees.com is launched, the first of a number of early social networking services
• 1999 – Napster peer-to-peer file sharing is launched.
• 2001 – Cyworld adds social networking features and becomes the first of a number of mass-market social networking service
• 2003 – Skype video calling software is launched.
• 2004 – Facebook is launched, becoming the largest social networking site in 2009.
• 2005 – YouTube, the video sharing site, is launched.
• 2006 – Twitter is launched.
• 2007 – iPhone is launched.
• 2009 – Whatsapp is launched.
• 2010 – Instagram is launched.
• 2011 – Snapchat is launched.
• 2015 – Discord is launched.

Timeline of rocket and missile technology

• 11th century AD - The first documented record of gunpowder and the fire arrow, an early form of rocketry, appears in the Chinese text Wujing Zongyao.
• 1633 - Lagâri Hasan Çelebi launched a 7-winged rocket using 50 okka (140 lbs) of gunpowder from Sarayburnu, the point below Topkapı Palace in Istanbul.

• 1650 - Artis Magnae Artillieriae pars prima ("Great Art of Artillery, the First Part") is printed in Amsterdam, about a year before the death of its author, Kazimierz Siemienowicz.

• 1664 - A "space rocket" is imagined as a future technology to be studied in France and its drawing is ordered by French finance minister Colbert; designed by Le Brun on a Gobelins tapestry.

• 1798 - Tipu Sultan, the King of the state of Mysore in India, develops and uses iron rockets against the British Army.

• 1801 - The British Army develops the Congreve rocket based on weapons used against them by Tipu Sultan.

• 1806 - Claude Ruggieri, an Italian living in France, launched animals on rockets and recovered them using parachutes. He was prevented from launching a child by police.

• 1813 - "A Treatise on the Motion of Rockets" by William Moore – first appearance of the rocket equation.

• 1818 - Henry Trengrouse demonstrates his rocket apparatus for projecting a lifeline from a wrecked ship to the shore, later widely adopted.

• 1844 - William Hale invents the spin-stabilized rocket.

• 1861 - William Leitch publishes an essay "A Journey Through Space" (later published in his book God to the Moon] as a humorous science fantasy story about a space gun launching a manned spacecraft equipped with rockets for landing on the Moon, but eventually used for another orbital maneuver.

• 1902 - French cinema pioneer Georges Méliès directs A Trip to the Moon, the first film about space travel.

• 1903 - Konstantin Tsiolkovsky begins a series of papers discussing the use of rocketry to reach outer space, space suits, and colonization of the Solar System. Two key points discussed in his works are liquid fuels and staging.

• 1913 - Without knowing the work of Russian mathematician Konstantin Tsiolkovsky, French engineer Robert Esnault-Pelterie derived the equations for space flight, produced a paper that presented the rocket equation and calculated the energies required to reach the Moon and nearby planets.

• 1916 - first use of rockets (with the solid fuel Le Prieur rocket) for both air-to-air attacks, and air to ground.

• 1922 - Hermann Oberth publishes his scientific work about rocketry and space exploration: Die Rakete zu den Planetenräumen ("By Rocket into Planetary Space").

• 1924 - Society for Studies of Interplanetary Travel founded in Moscow by Konstantin Tsiolkovsky, Friedrich Zander and 200 other space and rocket experts.

• 1926 - Robert Goddard launches the first liquid fuel rocket. This is considered by some to be the start of the Space Age.

• 1927 - Verein für Raumschifffahrt (VfR - "Spaceflight Society") founded in Germany.
1929 - Woman in the Moon, considered to be one of the first "serious" science fiction films.

1931 - Friedrich Schmiedl attempts the first rocket mail service in Austria

1933 - Sergei Korolev and Mikhail Tikhonravov launch the first liquid-fueled rocket in the Soviet Union

1935 - Emilio Herrera Linares from Spain designed and made the first full-pressured astronaut suit, called the *escafandra estratónautica*. The Russians then used a model of Herrera's suit when first flying into space of which the Americans would then later adopt when creating their own space program

1936 - Research on rockets begins at the Guggenheim Aeronautical Laboratory at the California Institute of Technology (GALCIT), the predecessor to the Jet Propulsion Laboratory, under the direction of Frank Malina and Theodore von Kármán

1937 - Peenemünde Army Research Center founded in Germany

1938 - The Projectile Development Establishment founded at Fort Halstead for the United Kingdom's research into military solid-fuel rockets.

1939 - Katyusha multiple rocket launchers (Russian: Kariona) are a type of rocket artillery first built and fielded by the Soviet Union.

1941 - French rocket EA-41 is launched, being the first European liquid propellant working rocket (It was, however, preceded by the Peenemunde A5 and Soviet experiments.)

1941 - Jet Assisted Take Off JATO installed on US Army Air Corp Ercoupe aircraft occurred on 12 August in March Field, California.

1942 - Wernher von Braun and Walter Dornberger launch the first V-2 rocket at Peenemünde in northern Germany.

1942 - A V-2 rocket reaches an altitude of 85 km.

1944 - The V-2 rocket MW 18014 reaches an altitude of 176 km, becoming the first man-made object in space.

1945 - Lothar Sieber dies after the first vertical take-off manned rocket flight in a Bachem Ba 349 "Natter"

1945 - Operation Paperclip takes 1,600 German rocket scientists and technicians to the United States

1945 - Operation Osoaviakhim takes 2,000 German rocket scientists and technicians to the Soviet Union

1946 - First flight of the Nike missile, later the first operational surface-to-air guided missile

1947 - Chuck Yeager achieves the first manned supersonic flight in a Bell X-1 rocket-powered aircraft

1949 - Willy Ley publishes *The Conquest of Space*

1952 - 22 May, French Véronique I rocket is launched from the Algerian desert.

1952 - Wernher von Braun discusses the technical details of a manned exploration of Mars in *Das Marsprojekt*. 
• **1953** - Colliers magazine publishes a series of articles on man's future in space, igniting the interest of people around the world. The series includes numerous articles by Ley and von Braun, illustrated by Chesley Bonestell.

• **1956** - First launch of PGM-17 Thor, the first US ballistic missile and forerunner of the Delta space launch rockets

• **1957** - Launch of the first ICBM, the USSR's R-7 (8K71), known to NATO as the SS-6 Sapwood.

• **1957** - The USSR launches Sputnik 1, the first artificial satellite.

• **1958** - The U.S. launches Explorer 1, the first American artificial satellite, on a Jupiter-C rocket.

• **1958** - US launches their first ICBM, the Atlas-B (the Atlas-A was a test article only).

• **1961** - The USSR launches Vostok 1, Yuri Gagarin reached a height of 327 km above Earth and was the first man to orbit Earth.

• **1961** - US, a Mercury capsule named Freedom 7 with Alan B. Shepard, spacecraft was launched by a Redstone rocket on a ballistic trajectory suborbital flight. It was the first human space mission that landed with pilot still in spacecraft, thus the first complete human spaceflight by FAI definitions.

• **1962** - The US launches Mercury MA-6 (Friendship 7) on an Atlas D booster, John Glenn puts America in orbit.

• **1963** - The USSR launches Vostok 6, Valentina Tereshkova was the first woman (and first civilian) to orbit Earth. She remained in space for nearly three days and orbited the Earth 48 times.

• **1963** - US X-15 rocket-plane, the first reusable manned spacecraft (suborbital) reaches space, pioneering reusability, carried launch and glide landings.

• **1965** - USSR Proton rocket, highly successful launch vehicle with notable payloads, Salyut 6 and Salyut 7, Mir, and ISS components

• **1965** - Robert Salked investigates various single stage to orbit spaceplane concepts

• **1966** - USSR Luna 9, the first soft landing on the Moon

• **1966** - USSR launches Soyuz spacecraft, longest-running series of spacecraft, eventually serving Soviet, Russian and International space missions.

• **1968** - USSR Zond 5, two tortoises and smaller biological Earthlings circle the Moon and return safely to Earth.

• **1968** - US Apollo 8, the first men to reach and orbit the Moon.

• **1969** - US Apollo 11, first men on the Moon, first lunar surface extravehicular activity.

• **1981** - US Space Shuttle pioneers reusability and glide landings

• **1998** - US Deep Space 1 is first deep space mission to use an ion thruster for propulsion.

• **1998** - Russia launch Zarya module which is the first part of the International Space Station.
• 2001 - Russian Soyuz spacecraft sent the first space tourist Dennis Tito to International Space Station.
• 2004 - US-based, first privately developed, manned (suborbital) spaceflight, SpaceShipOne demonstrates reusability.
• 2008 - SpaceX—with their Falcon 1 rocket—became the first private entity to successfully launch a rocket into orbit.
• 2012 - The SpaceX Dragon space capsule—launched aboard a Falcon 9 launch vehicle—was the first private spacecraft to successfully dock with another spacecraft, and was also the first private capsule to dock at the International Space Station.
• 2014 - First booster rocket returning from an orbital trajectory to achieve a zero-velocity-at-zero-altitude propulsive vertical landing. The first-stage booster of Falcon 9 Flight 9 made the first successful controlled ocean soft touchdown of a liquid-rocket-engine orbital booster on April 18, 2014.
• 2015 - SpaceX's Falcon 9 Flight 20 was the first time that the first stage of an orbital rocket made a successful return and vertical landing.
• 2017 - SpaceX's Falcon 9 SES-10 was the first time a used orbital rocket made a successful return
• 2018 - The Electron rocket was the first New-Zealand rocket to achieve orbit. The rocket is also unique in using an electric pump-fed engine. The rocket also carried an additional satellite payload called "Humanity Star", a 1-meter-wide (3 ft) carbon fiber sphere made up of 65 panels that reflect the Sun's light.

Timeline of states of matter and phase transitions

• 1895 – Pierre Curie discovers that induced magnetization is proportional to magnetic field strength
• 1911 – Heike Kamerlingh Onnes discloses his research on superconductivity
• 1912 – Peter Debye derives the T-cubed law for the low temperature heat capacity of a nonmetallic solid
• 1925 – Ernst Ising presents the solution to the one-dimensional Ising model
• 1928 – Felix Bloch applies quantum mechanics to electrons in crystal lattices, establishing the quantum theory of solids
• 1929 – Paul Adrien Maurice Dirac and Werner Karl Heisenberg develop the quantum theory of ferromagnetism
• 1932 – Louis Eugène Félix Néel discovers antiferromagnetism
• 1933 – Walther Meissner and Robert Ochsenfeld discover perfect superconducting diamagnetism
• 1933–1937 – Lev Davidovich Landau develops the Landau theory of phase transitions
• 1937 – Pyotr Leonidovich Kapitsa and John Frank Allen discover superfluidity
1941 – Lev Davidovich Landau explains superfluidity
1942 – Hannes Alfvén predicts magnetohydrodynamic waves in plasmas
1944 – Lars Onsager publishes the exact solution to the two-dimensional Ising model
1957 – John Bardeen, Leon Cooper, and Robert Schrieffer develop the BCS theory of superconductivity
End of the 50s – Lev Davidovich Landau develops the theory of Fermi liquid
1959 – Philip Warren Anderson predicts localization in disordered systems
1972 – Douglas Osheroff, Robert C. Richardson, and David Lee discover that helium-3 can become a superfluid
1974 – Kenneth G. Wilson develops the renormalization group technique for treating phase transitions
1980 – Klaus von Klitzing discovers the quantum Hall effect
1982 – Horst L. Stoermer and Daniel C. Tsui discover the fractional quantum Hall effect
1983 – Robert B. Laughlin explains the fractional quantum Hall effect
1987 – Karl Alexander Müller and Georg Bednorz discover high critical temperature ceramic superconductors

Timeline of postal history

- **First century** - Cursus publicus, the state-run courier (and transportation) service of the Roman Empire was established by Augustus.
- **1497** - Franz von Taxis established a postal service on behalf of Emperor Maximilian I of the Holy Roman Empire
- **1516** - Henry VIII established a "Master of the Posts"
- **1520** - Manuel I creates the public mail service of Portugal, the Correio Público-Public Post Office.
- **1558, 18 October** - Sigismund II Augustus established Poczta Polska, a postal service of the Polish-Lithuanian Commonwealth.
- **1635, 31 July** - Charles I made the Royal Mail service available to the public for the first time with postage being paid by the recipient.
- **1639** - The General Court of Massachusetts designates the tavern of Richard Fairbanks in Boston as the official repository of overseas mail, making it the first postal establishment in the 13 colonies.
- **1647, 7 January** - H. Morian Granted license på have a postal monopoly "Posten Norge".
- **1654** - Oliver Cromwell grants monopoly over service in England to "Office of Postage".
- **1660** - General Post Office established in England by Charles II.
- **1663** - England's Imperial Post Office is established in the Colony of Barbados.
- **1663** - Portugal's Correio-Mor das Cartas do Mar is established in Rio de Janeiro by the 7th High-Courier of the Kingdom of Portugal, Luís Gomes da Mata.
- **1671** - King Louis XIV grants monopoly over service in Paris to the family Pagot and Rouillé.
- **1675** - Beat Fischer von Reichenbach granted permission to operate a private postal service in Bern, Switzerland.
- **1680** - The first penny post system, known as the **London Penny Post**, for local delivery was introduced by William Dockwra in London.
- **1690** - Leon II Pajot builds a privately operated postal center on 9 rue des Déchargeurs in Paris - International Horse Carriages carry Mail from Paris to Pajot et Rouillé or Thurn und Taxis Post relais around western Europe. The building, the Hotel de Villeroy still exists, it is used today for private apartments and for the exposition center **Cremerie de Paris**, the private courtyard can be visited by the public certain days in the summer.
- **1738** – the Parisian postal family Pajot and Rouille had become one of the wealthiest families in France. The Royal French minister of finance cardinal de Fleury estimates that the postal wealth should belong to the Kings of France and nationalizes the privately run postal enterprise. The postal service also leaves the historic Pajot & Rouille buildings (formerly Hotel de Villeroy) located on rue des Dechargeurs / rue des Bourdonnais.
- **1775** - The Continental Congress appoints Benjamin Franklin to be the first United States Postmaster General.
- **1792, 20 February** - The US Postal Service Act establishes the United States Post Office Department.
- **1825** - The US establishes a dead letter office.
- **1828** - Hellenic postal service established.
- **1830** – First mail train in United Kingdom of Great Britain and Ireland.
- **1831** - Independent Irish and Scottish Post Offices united under the Postmaster General of the United Kingdom, 31 years after the Act of Union.
- **1839, 5 December** - Uniform Fourpenny Post starts throughout the UK.
- **1840, 10 January** - Uniform Penny Post starts throughout the United Kingdom.
- **1840, 1 May** - United Kingdom issues the Penny Black and Two Pence Blue, the world's first postage stamps.
- **1840, 6 May** - The Penny Black and Two Pence Blue, world's first postage stamps, become valid for the pre-payment of postage.
- **1842, 1 February** - City Despatch Post New York local post.
- 1843, 1 March - Zürich issue their first stamps: Zurich 4 and Zurich 6.
- 1843, 1 August - Bull's Eyes, first stamps of Brazil
- 1843, 30 September - Geneva issue their first stamps: Double Geneva.
- 1845 - Creation of the New York Postmaster's Provisional
- 1845 - The US star routes begin operation.
- 1847, 1 July - The United States issues its first stamps.
- 1847, 21 September - Mauritius issues its first stamps, the Mauritius "Post Office" stamps, or the Red Penny and Blue Penny.
- 1848 - first use of Perot Provisionals in Bermuda
- 1849, 1 January - first stamps of France
- 1849, 1 July - first stamps of Belgium, known as the "Epaulettes" type
- 1849, 1 November - first stamps of Bavaria
- 1850, 1 January - New South Wales issues its first stamps.
- 1850, 1 January - Spain issues its first stamps.
- 1850, 3 January - Victoria issues its first stamps.
- 1850, 7 April - Federal Switzerland issues its first stamps.
- 1850, 1 June - Austria and Kingdom of Lombardy-Venetia issue their first stamps.
- 1850, 29 June - Saxony issues its first stamps.
- 1850, 1 July - British Guiana issues its first stamps.
- 1850, 15 November - Prussia issues its first stamps.
- 1851, 1 April - Denmark issues its first stamp.
- 1851, 23 April - The Province of Canada issues its first stamp, the Three-Penny Beaver, designed by Sandford Fleming.
- 1851 - Kingdom of Hawaii issues Hawaiian Missionaries, first stamps.
- 1851 - New Brunswick issues its first stamps.
- 1852 - The Netherlands issues its first stamps.
- 1852 - Scinde Dawks in India
- 1852 - first stamps of Barbados
- 1852 - US issues its first stamped envelopes.
- 1853 - first stamps of Portugal
- 1853, 1 November - first stamps of Tasmania
• 1854 - first stamps of India
• 1854 - first stamps of Western Australia
• 1855 - first stamps of South Australia
• 1855 - US initiates registered mail service.
• 1855 - US makes prepayment of postage compulsory.
• 1855 - first stamps of New Zealand
• 1856, 1 August - first stamps of Mexico
• 1856, 21 August - first stamps of Corrientes
• 1856 - first stamps of Danish West Indies
• 1856 - British Guiana 1c magenta issued
• 1857, 1 April - Ceylon(Sri Lanka) issues its first stamp.
• 1857 - Newfoundland issues its first stamps.
• 1858, 29 April - Buenos Aires issues its first stamps.
• 1858, 1 May - Argentine Confederation issues its first stamps.
• 1858, 21 July - Moldavia issues its first stamps, just a year before the state's dissolution.
• 1858, 28 October - Cordoba issues its first stamps.
• 1858 - London is divided into postal districts, precursor of British Postcode System.
• 1859 - Bahamas issues its first stamps.
• 1860, 1 November - first stamps of Queensland
• 1860, 1 December - first stamps of Malta
• 1860 - Jamaica issues its first stamps.
• 1860 - The Pony Express operates in the western United States for a short time.
• 1860 - A stamp is issued for British Columbia and Vancouver Island.
• 1861 - American Civil War begins, postmasters in South make provisional issues.
• 1861 - first official stamps of Confederate States of America
• 1861, 1 October - first stamps of Greece
• 1862, 11 January - first stamps of Argentine Republic
• 1862 - first stamps of Antigua
• 1863 - Bolivia creates a private contract for mail but rescinds it six weeks later.
• 1863 - First stamps issued by the Ottoman Empire.
• 1864 - United States establishes railroad post offices.
• 1865, 1 November - British Columbia issues first stamps.
• 1865 - Bermuda has its first regular stamp issue.
• 1865 - Vancouver Island issues only stamps solely for the island.
• 1866 - first stamps of Serbia
• 1866 - British Honduras issues its first stamps.
• 1866 - Lombardy-Venetia annexed by Italy, including postal services
• 1866 - first stamps of Egypt
• 1867, 1 July - The State of Prussia nationalizes the centuries-old private Thurn und Taxis Post.
• 1867, 1 July - The Province of Canada is joined by Nova Scotia and New Brunswick, creating the Dominion of Canada.
• 1867 - first stamps of Bolivia
• 1867 - first stamps of Austrian post offices in the Turkish Empire
• 1868 - first stamps of Persia
• 1868 - first stamps of Azores
• 1870 - Angola issues its first stamps.
• 1871 - Afghanistan issues its first stamps.
• 1871, 20 April - Japan issues its first stamps.
• 1871, 20 July - British Columbia joins Canada, which takes over postal services.
• 1873, 1 July - Prince Edward Island joins Canada, which takes over postal services.
• 1873 - Iceland issues its first stamps.
• 1874, 9 October - General Postal Union (later Universal Postal Union) is formed.
• 1878 - General Postal Union becomes the Universal Postal Union.
• 1879, 1 June - Bulgaria issues its first stamps a year after its independence.
• 1882 - stamps of Straits Settlements overprinted at Bangkok
• 1883 - first stamps of Siam (Thailand)
• 1885 - United States initiates special delivery service.
• 1886 - first stamps of British Bechuanaland
• 1886 - first stamps of Congo Free State (Belgian Congo)
• 1888 - first stamps of Bechuanaland Protectorate
• 1890 - first stamps of the Republic of the United States of Brazil
• 1890 - first stamps of British East Africa
• 1891 - first stamps of British Central Africa
• 1892, January 2 - first stamps of British South Africa Company, Rhodesia
• 1892 - first stamps of Anjouan
• 1892 - first stamps of Angra
• 1892 - first stamps of Benin
• 1893 - Hawaiian monarchy overthrown, first stamps of republic
• 1895 - stamps of Dahomey supersede those of Benin
• 1894 - first stamps of French Somali Coast (today Djibouti)
• 1896 - United States experiments with rural free delivery, is made permanent in 1902.
• 1897 - Germany issues first stamps for its colony of Kamerun.
• 1898 - First stamps of Cuba under American military occupation
• 1898 - Puerto Rico stamps issued under US administration
• 1899 - US stamps overprinted for use in Guam
• 1899 - first stamps of the Philippines (overprinted US issues)
• 1899 - US stamps supersede those of Hawaii
• 1900 - first stamps of Kiautschou, German colony in China
• 1903 - first stamps of Aitutaki
• 1903 - first stamps of Austrian post offices in Crete
• 1904 - first stamps of Panama Canal Zone
• 1906 - first stamps of Brunei, overprints on Labuan
• 1908 - first stamps of the Belgian Congo under Belgian administration
• 1911, January 1 - first stamps of the Gilbert and Ellice Islands.
• 1911 - United States creates a postal savings system.
• 1912 - last stamps of Anjouan, superseded by Madagascar
• 1913 - first stamps of Australia, superseding those of the various former colonies
• 1913, May - first stamps of Albania
• 1913 - United States initiates parcel post service, using special stamps.
• 1915, August 15 - British forces overprint Iranian stamps in Bushire, use until 16 October.
• 1915 - British and French occupation forces overprint stamps for Cameroon.
• 1916 - United States postal inspectors solve the last known stagecoach robbery in the US.
• 1917 - British armed forces in Palestine issue the famous EEF stamps. December 1917
• 1918 - United States issues its first airmail stamps; a sheet of the Inverted Jenny is discovered among them.
• 1918 - first stamps of the Italian occupation of Trieste and Trentino
• 1919 - first stamps of Armenia and Azerbaijan
• 1919 - first stamps of Batum
• 1920 - plebiscite stamps for Allenstein
• 1920 - largest private US postage company, Pitney Bowes formed.
• 1920 - first stamps of French Upper Volta
• 1920 - first stamps of La Aguera
• 1921 - East Africa and Uganda Protectorates issues stamps.
• 1921 - France issues first stamps for its mandate of Cameroon.
• 1922, 13 July - Barbuda overprints stamps of Leeward Islands.
• 1922 - Karelia, briefly independent, issues stamps
• 1922 - first stamps of British Kenya and Uganda
• 1922 - first stamps of Ascension Island
• 1922 - last stamps of La Aguera
• 1922 - first stamps of Irish Free State
• 1923 - first stamps of Jordan (as a British mandate)
• 1923 - first stamps of Transcaucasian SFSR, superseding those of Armenia
• 1923 - first stamps of Iraq
• 1923 - first stamps of Kuwait
• 1924 - first stamps of French Algeria
• 1925 - first stamps of Alaouites
• 1927- First new [4]stamps for the civil administration in Palestine.
• 1928 - first stamps of Spanish Andorra
• 1931, 16 June - first stamps of French Andorra
• 1933, 10 August - first stamps of Bahrain, issued by Indian postal administration
• 1933, 1 December - first stamps of Basutoland
• 1935 - common issue of stamps for Silver Jubilee of King George V
• 1935, 15 November - first stamps of Commonwealth of the Philippines
• 1935 - first stamps of Kenya, Uganda, Tanganyika
• 1935 - United States initiates Trans-Pacific airmail service.
• 1937, 1 April - first stamps of Aden
• 1937, 1 April - first stamps of Burma, overprints on India
• 1937, 12 May - common issue of stamps for coronation of King George VI
• 1938, 14 April - stamps issued for Alexandretta, last on 10 November
• 1938 - Austrian stamps are phased out after the Anschluss.
• 1939 - Postal censorship introduced in several countries, both combatants and neutrals, involved in World War II
• 1940 - Pitcairn Islands issue their first stamps.
• 1941 - United States creates highway post offices.
• 1942 - United States uses V-mail to handle armed forces' mail.
• 1945 - provisional stamps issued for Austria
• 1946 - first stamps of independent Jordan
• 1947 - India gains independence from Britain
• 1948 - Israel issues its first stamps-The Doar Ivri set. 16 May 1948 [The new country still has no name]
• 1948 - Israel issues its first Israel stamps with the word ISRAEL on the stamps. 26 September 1948
• 1948 - British postal administration takes over in Bahrain
• 1948 - Pakistan issues its first stamps.
• 1949 - Newfoundland joins Canada and issues its last stamps.
• 1949, 18 July - Ryukyu Islands issues its first stamps.
• 1951 - Cambodia issues its first stamps.
• 1951 - United Nations issues its first stamps.
• 1955 - United States initiates certified mail service.
• 1957 - United States establishes Citizens' Stamp Advisory Committee to choose stamp designs
• 1958, 23 April - members of West Indies Federation make a joint stamp issue.
• 1959 - UK Postcode scheme introduced.
• 1959 - The Republic of Upper Volta issues its first stamps.
• 1959 - The USS Barbero and United States Postal Service attempt the delivery of mail via Missile Mail.
• 1960 - Katanga secedes from Congo, issues stamps until 1961.
• 1960, 1 October - UK trust territory of the Cameroons issues stamps, in use into 1961.
• 1961, 1 October - Independent Cameroon issues its first stamps.
• 1962 - Bhutan issues its first stamps.
- 1962, 1 July - Burundi issues its first stamps.
- 1963 - United States introduces the ZIP Code.
- 1963, 1 February - British Antarctic Territory issues its first stamps.
- 1963, 12 December - Kenya issues its first stamps.
- 1964 - First stamps issued by independent Republic of Malta.
- 1964, 9 February - Sierra Leone issues the world's first self-adhesive stamps.
- 1964, 30 March - Abu Dhabi issues its first stamps.
- 1964, 20 June - Ajman issues its first stamps.
- 1966, 30 September - first stamps of Botswana
- 1966, 2 December - first stamps of independent Barbados
- 1966 - United States ends its postal savings system.
- 1967, 21 August - first stamps of Afars and Issas
- 1967, 4 September - first stamps of Anguilla
- 1968, 17 January - first stamps of British Indian Ocean Territory
- 1968, 19 November - first regular stamps of Barbuda
- 1968 - United States initiates priority mail as a type of first-class mail.
- 1970 - United States passes Postal Reorganization Act, which changed the postal service from a government department to a corporation owned by the government.
- 1970 - United States initiates experimental express mail service, makes it permanent in 1977.
- 1971 - United States Postal Service begins operation as a corporation.
- 1971, 1 April - Canadian six-character postal codes introduced.
- 1971, 29 July - Bangladesh issues its first stamps.
- 1973, 1 June - Belize issues its first stamps.
- 1974 - United States ends its use of highway post offices.
- 1975, 11 November - first stamp of independent Angola
- 1975, 8 December - first stamps of renamed Benin
- 1976, 1 January - first stamps of Tuvalu, formerly the Ellice Islands.
- 1976, 1 January - first stamps of the Gilbert Islands (changed to Kiribati in 1979)
- 1977, 30 June - United States ends use of railroad post offices.
- 1978 - United States begins to copyright postage stamps and other philatelic items.
- 1979, 12 July - first stamps of Kiribati, formerly the Gilbert Islands.
• 1979 - Canal Zone transferred to Panama along with postal service.
• 1982 - United States introduces E-COM, an electronic message service.
• 1983 - United States introduces ZIP + 4.
• 1984, 21 November - first stamps of Burkina Faso
• 1985 - Jackie Strange, first female Deputy US Postmaster General
• 1985 - United States terminates E-COM service.
• 1986, 1 January - first stamps of Aruba
• 1992, 20 March - Belarus issues its first stamps.
• 1992, 26 March - Azerbaijan resumes issuing stamps.
• 1992 - Kazakhstan issues its first stamps.
• 1994, 28 January - Canada issues the world's first 2 part customizable greetings stamps.
• 2000, 28 December - Canada issues the world's first 2 part personalized photo stamps, called "Picture Postage".
• 2007, 12 April - USPS issues a non-denominated stamp called the forever stamp
• 2011, 13 July - newly independent South Sudan issues its first postage stamps.
• 2015, 1 February - Megan Brennan appointed first female US Postmaster General

Timeline of lighting technology

• 125,000 BC: Widespread control of fire by early humans.
• 70,000 BC: A hollow rock, shell, or other natural found object was filled with moss or a similar material that was soaked in animal fat and ignited.
• c. 4500 BC: oil lamps
• c. 3000 BC: candles are invented.
• 1780: Aimé Argand invents the central draught fixed oil lamp.
• 1784: Argand adds glass chimney to central draught lamp.
• 1792: William Murdoch begins experimenting with gas lighting and probably produced the first gas light in this year.
• 1800: French watchmaker Bernard Guillaume Carcel overcomes the disadvantages of the Argand-type lamps with his clockwork fed Carcel lamp.
• 1800-1809: Humphry Davy invents the arc lamp when using Voltaic piles (battery) for his electrolysis experiments.
• 1802: William Murdoch illuminates the exterior of the Soho Foundry with gas.
• 1805: Philips and Lee's Cotton Mill, Manchester was the first industrial factory to be fully lit by gas.
• 1809: Humphry Davy publicly demonstrates first electric lamp over 10,000 lumens, at the Royal Society.
• 1813: National Heat and Light Company formed by Fredrich Winzer (Winsor)
• 1815: Humphry Davy invents the miner's safety lamp.
• 1823: Johann Wolfgang Döbereiner invents the Döbereiner's lamp.
• 1835: James Bowman Lindsay demonstrates a light bulb based electric lighting system to the citizens of Dundee.
• 1841: Arc-lighting is used as experimental public lighting in Paris.
• 1853: Ignacy Lukasiewicz invents the modern kerosene lamp.
• 1856: glassblower Heinrich Geissler confines the electric arc in a Geissler tube.
• 1867: A. E. Becquerel demonstrates the first fluorescent lamp.
• 1874: Alexander Lodygin patents an incandescent light bulb.
• 1875: Henry Woodward patents an electric light bulb.
• 1876: Pavel Yablochkov invents the Yablochkov candle, the first practical carbon arc lamp, for public street lighting in Paris.
• 1879: Thomas Edison and Joseph Wilson Swan patent the carbon-thread incandescent lamp. It lasted 40 hours.
• 1880: Edison produced a 16-watt lightbulb that lasts 1500 hours.
• 1882: Introduction of large scale direct current based indoor incandescent lighting and lighting utility with Edison's first Pearl Street Station.
• 1883: GE introduces first commercial fully enclosed carbon arc lamp. Sealed in glass globes, it lasts 100h and therefore 10 times longer than hitherto carbon arc lamps.
• 1893: Nikola Tesla puts forward his ideas on high frequency and wireless electric lighting which included public demonstrations where he lit a Geissler tube wirelessly.
• 1894: D. McFarlan Moore creates the Moore tube, precursor of electric gas-discharge lamps.
• 1897: Walther Nernst invents and patents his incandescent lamp, based on solid state electrolytes.
• 1901: Peter Cooper Hewitt creates the first commercial mercury-vapor lamp.
• 1904: Alexander Just and Franjo Hanaman invent the tungsten filament for incandescent lightbulbs.
• 1910: Georges Claude demonstrates neon lighting at the Paris Motor Show.
• 1912: Charles P. Steinmetz invents the metal-halide lamp.
• 1913: Irving Langmuir discovers that inert gas could double the luminous efficacy of incandescent lightbulbs.
• 1917: Burnie Lee Benbow patents the coiled coil filament.
• 1920: Arthur H. Compton invents the sodium-vapor lamp.
• 1921: Junichi Miura creates the first incandescent lightbulb to utilize a coiled coil filament.
• 1925: Marvin Pipkin invents the first internal frosted lightbulb.
• 1926: Edmund Germer patents the modern fluorescent lamp.
• 1927: Oleg Losev creates the first LED (light-emitting diode).
• 1953: Elmer Fridrich invents the halogen light bulb.
• 1953: André Bernanose and several colleagues observe electroluminescence in organic materials.
• 1960: Theodore H. Maiman creates the first laser.
• 1962: Nick Holonyak Jr. develops the first practical visible-spectrum (red) light-emitting diode.
• 1963: Kurt Schmidt invents the first high pressure sodium-vapor lamp.
• 1972: M. George Craford invents the first yellow light-emitting diode.
• 1972: Herbert Paul Maruska and Jacques Pankove create the first violet light-emitting diode.
• 1981: Philips sells their first Compact Fluorescent Energy Saving Lamps, with integrated conventional ballast.
• 1981: Thorn Lighting Group exhibits the ceramic discharge metal-halide lamp.
• 1985: Osram answers with the first electronic Energy Saving Lamps to be very successful.
• 1987: Ching W. Tang and Steven Van Slyke at Eastman Kodak create the first practical organic light-emitting diode (OLED).
• 1990: Michael Ury, Charles Wood, and several colleagues develop the sulfur lamp.
• 1991: Philips invents a fluorescent lightbulb that lasts 60,000 hours using magnetic induction.
• 1994: T5 lamps with cool tip are introduced to become the leading fluorescent lamps with up to 117 lm/W with good color rendering. These and almost all new fluorescent lamps are to be operated on electronic ballasts only.
• 1994: The first commercial sulfur lamp is sold by Fusion Lighting.
• **1995:** Shuji Nakamura at Nichia labs invents the first practical blue and with additional phosphor, white LED, starting an LED boom.

• **2008:** Ushio Lighting demonstrates the first LED Filament.

• **2011:** Philips wins L Prize for LED screw-in lamp equivalent to 60W incandescent A-lamp for general use.

**Timeline of time measurement technology**

- **270 BCE** - Ctesibius builds a popular water clock, called a clepsydra
- **46 BCE** - Julius Caesar and Sosigenes develop a solar calendar with leap years
- **11th century** - Sets of hourglasses were maintained by ship's pages to mark the progress of a ship during its voyage
- **11th century** - Large town clocks were used in Europe to display local time, maintained by hand
- **1335** - First known mechanical clock, in Milan
- **1502** - Peter Henlein builds the first pocketwatch
- **1582** - Pope Gregory XIII, Aloysius Lilius, and Christopher Clavius introduce a Gregorian calendar with an improved leap year system
- **1655** - Cassini builds the heliometer of San Petronio in Bologna, to standardize Solar noon.
- **1656** - Christiaan Huygens builds the first accurate pendulum clock
- **1676** - Motion works and minute hand introduced by Daniel Quare
- **1680** - Second hand introduced
- **1737** - John Harrison presents the first stable marine chronometer, thereby allowing for precise longitude determination while at sea
- **1850** - Aaron Lufkin Dennison starts in Roxbury, Mass. U.S.A. the Waltham Watch Company and develops the American System of Watch Manufacturing.
- **1884** - International Meridian Conference adopts Greenwich Mean Time for consistency with Nevil Maskelyne's 18th century observations for the Method of Lunar Distances
- **1893** - Introduction by Webb C. Ball of the General Railroad Timepiece Standards in North America: Railroad chronometers
- **1928** - Joseph Horton and Warren Morrison build the first quartz crystal oscillator clock
- **1946** - Felix Bloch and Edward Purcell develop nuclear magnetic resonance
- **1949** - Harold Lyons develops an atomic clock based on the quantum mechanical vibrations of the ammonia molecule
• **1982** - The Federation of the Swiss Watch Industry FH is founded by the merger of two previous organisations
• **1983** - Radio-controlled clocks become common place in Europe
• **1983** - First collection of 12 Swatch models went on sale on March 1, in Zurich - the first fashion watch
• **1994** - Radio-controlled clocks become common place in USA

**Timeline of materials technology**

- **28,000 BC** – People wear beads, bracelets, and pendants
- **14,500 BC** – First pottery, made by the Jōmon people of Japan.
- **3rd millennium BC** – Copper metallurgy is invented and copper is used for ornamentation
- **2nd millennium BC** – Bronze is used for weapons and armor
- **16th century BC** – The Hittites develop crude iron metallurgy
- **13th century BC** – Invention of steel when iron and charcoal are combined properly
- **10th century BC** – Glass production begins in ancient Near East
- **1st millennium BC** – Pewter beginning to be used in China and Egypt
- **1000 BC** – The Phoenicians introduce dyes made from the purple murex.
- **3rd century BC** – Wootz steel, the first crucible steel, is invented in ancient India
- **50s BC** – Glassblowing techniques flourish in Phoenicia
- **20s BC** – Roman architect Vitruvius describes low-water-content method for mixing concrete
- **3rd century** – Cast iron widely used in Han Dynasty China
- **300** – Greek alchemist Zomi, summarizing the work of Egyptian alchemists, describes arsenic and lead acetate
- **4th century** – Iron pillar of Delhi is the oldest surviving example of corrosion-resistant steel
- **720** – Abu Masa Dshaffar discovers sulfuric acid, nitric acid, aqua regia, and silver nitrate
- **750** – Geber, an Arabian alchemist, describes the preparation of aluminum chloride, white lead, nitric acid, and acetic acid
- **8th century** – Porcelain is invented in Tang Dynasty China
- **8th century** – Tin-glazing of ceramics invented by Arabic chemists and potters in Basra, Iraq
- **9th century** – Stonepaste ceramics invented in Iraq
- 900 – Al-razi, known as Rhazes, a Persian physician and alchemist, describes the preparation of plaster of Paris and metallic antimony
- 9th century – Lustreware appears in Mesopotamia
- 1000 – Gunpowder is developed in China
- 1340 – In Liège, Belgium, the first blast furnaces for the production of iron are developed
- 1448 – Johann Gutenberg develops type metal alloy
- 1450s – Cristallo, a clear soda-based glass, is invented by Angelo Barovier
- 1540 – Vannoccio Biringuccio publishes first systematic book on metallurgy
- 1556 – Georg Agricola's influential book on metallurgy
- 1590 – Glass lenses are developed in the Netherlands and used for the first time in microscopes and telescopes
- 1664 – In the pipes supplying water to the gardens at Versailles, cast iron is used
- 1717 – Abraham Darby makes iron with coke, a derivative of coal
- 1738 – Metallic zinc processed by distillation from calamine and charcoal patented by William Champion
- 1740 – Crucible steel technique developed by Benjamin Huntsman
- 1774 – Joseph Priestley discovers oxygen, Johann Gottlieb Gahn discovers manganese, Karl Wilhelm Scheele discovers chlorine
- 1779 – Hydraulic cement (stucco) patented by Bryan Higgins for use as an exterior plaster
- 1799 – Acid battery made from copper/zinc by Alessandro Volta
- 1821 – Thermocouple invented by Thomas Johann Seebeck
- 1824 – Portland cement patent issued to Joseph Aspdin
- 1825 – Metallic aluminum produced by Hans Christian Ørsted
- 1839 – Vulcanized rubber invented by Charles Goodyear
- 1839 – Silver-based photographic processes invented by Louis Daguerre and William Fox Talbot
- 1855 – Bessemer process for mass production of steel patented by Henry Bessemer
- 1861 – Color photography demonstrated by James Clerk Maxwell
- 1883 – First solar cells using selenium waffles made by Charles Fritts
- 1893 – Thermite Welding developed and soon used to weld rails
- 1902 – Synthetic rubies created by the Verneuil process developed by Auguste Verneuil
- 1908 – Cellophane invented by Jacques E. Brandenberger
- 1909 – Bakelite hard thermosetting plastic presented by Leo Baekeland
1911 – Superconductivity discovered by Heike Kamerlingh Onnes
1912 – Stainless steel invented by Harry Brearley
1916 – Method for growing single crystals of metals invented by Jan Czochralski
1919 – The merchant ship Fullagar has the first all welded hull.
1924 – Pyrex invented by scientists at Corning Incorporated, a glass with a very low coefficient of thermal expansion
1931 – synthetic rubber called neoprene developed by Julius Nieuwland
1931 – Nylon developed by Wallace Carothers
1938 – The process for making poly-tetrafluoroethylene, better known as Teflon discovered by Roy Plunkett
1939 – Dislocations in metals confirmed by Robert W. Cahn
1947 – First germanium point-contact transistor invented
1947 – First commercial application of a piezoelectric ceramic: barium titanate used as a phonograph pickup
1951 – Individual atoms seen for the first time using the field ion microscope
1953 – Metallic catalysts which greatly improve the strength of polyethylene polymers discovered by Karl Ziegler
1954 – Silicon solar cells with 6% efficiency made at Bell Laboratories
1954 – Argon oxygen decarburization (AOD) refining invented by scientists at the Union Carbide Corporation
1959 – Float glass process patented by the Pilkington Brothers
1962 – SQUID superconducting quantum interference device invented
1968 – Liquid crystal display developed by RCA
1970 – Silica optical fibers grown by Corning Incorporated
1980 – Duplex stainless steels developed which resist oxidation in chlorides
1984 – Fold-forming system developed by Charles Lewton-Brain to produce complex three dimensional forms rapidly from sheet metal
1985 - The first fullerene molecule discovered by scientists at Rice University
1986 - The first high temperature superconductor is discovered by Georg Bednorz and K. Alex Müller

Timeline of low-temperature technology
• c. 2000 BC - 1387 AD – Aryan (Pagan) kingdom between Baltic and Black seas used basements filled with ice during Winter as refrigerators through Summer.
• c. 1700 BC – Zimri-Lim, ruler of Mari in Syria commanded the construction of one of the first ice houses near the Euphrates.
• c. 500 BC – The yakhchāl (meaning "ice pit" in Persian) is an ancient Persian type of refrigerator. The structure was formed from a mortar resistant to heat transmission, in the shape of a dome. Snow and ice was stored beneath the ground, effectively allowing access to ice even in hot months and allowing for prolonged food preservation. Often a bādgīr was coupled with the yakhchāl in order to slow the heat loss. Modern refrigerators are still called yakhchāl in Persian.
• c.a. 60 AD - Hero of Alexandria knew of the principle that certain substances, notably air, expand and contract and described a demonstration in which a closed tube partially filled with air had its end in a container of water. The expansion and contraction of the air caused the position of the water/air interface to move along the tube. This was the first established principle of gas behaviour vs temperature, and principle of first thermometers later on. The idea could predate him even more (Empedocles of Agrigentum in his 460 B.C. book On Nature).
• 1396 AD - Ice storage warehouses called "Dong-bing-go-tango" (meaning "east ice storage warehouse" in Korean) and Seo-bing-go ("west ice storage warehouse") were built in Han-Yang (currently Seoul, Korea). The buildings housed ice that was collected from the frozen Han River in January (by lunar calendar). The warehouse was well-insulated, providing the royal families with ice into the summer months. These warehouses were closed in 1898 AD but the buildings are still intact in Seoul.
• 1593 – Galileo Galilei builds a first modern thermoscope. But it is possible the invention was by Santorio Santorio or independently around same time by Cornelis Drebble. The principle of operation was known in Ancient Greece.
• c.a. 1611-1613 – Francesco Sagredo or Santorio Santorio, put a numerical scale on a thermoscope.
• 1617 – Giuseppe Biancani publishes first clear diagram of thermoscope
• 1638 – Robert Fludd describes thermometer with a scale, using air thermometer principle with column of air and liquid water.
• 1650 – Otto von Guericke designed and built the world's first vacuum pump and created the world's first ever vacuum known as the Magdeburg hemispheres to disprove Aristotle's long-held supposition that 'Nature abhors a vacuum'.
• 1656 – Robert Boyle and Robert Hooke built an air pump on this design.
• 1662 – Boyle's law (gas law relating pressure and volume) is demonstrated using a vacuum pump
• 1665 – Boyle theorizes a minimum temperature in New Experiments and Observations touching Cold.
• 1679 – Denis Papin – safety valve
• 1702 – Guillaume Amontons first calculates absolute zero to be −240 °C using an air thermometer of his own invention (1702), theorizing at this point the gas would reach zero volume and zero pressure.

• 1714 – Daniel Gabriel Fahrenheit invented the first reliable thermometer, using mercury instead of alcohol and water mixtures

• 1724 – Daniel Gabriel Fahrenheit proposes a Fahrenheit scale, which had finer scale and greater reproducibility than competitors.

• 1730 – René Antoine Ferchault de Réaumur invented an alcohol thermometer and temperature scale ultimately proved to be less reliable than Fahrenheit's mercury thermometer.

• 1742 – Anders Celsius proposed a scale with zero at the boiling point and 100 degrees at the freezing point of water. It was later changed to be the other way around, on the input from Swedish academy of science.

• 1756 – The first documented public demonstration of artificial refrigeration by William Cullen

• 1782 – Antoine Lavoisier and Pierre-Simon Laplace invent the ice-calorimeter

• 1784 – Gaspard Monge liquefied the first gas producing liquid sulfur dioxide.

• 1787 – Charles's law (Gas law, relating volume and temperature)

• 1802 – John Dalton wrote "the reducibility of all elastic fluids of whatever kind, into liquids"

• 1802 – Gay-Lussac's law (Gas law, relating temperature and pressure).

• 1803 – Domestic ice box

• 1803 – Thomas Moore of Baltimore, Md. received a patent on refrigeration.

• 1805 – Oliver Evans designed the first closed circuit refrigeration machine based on the vapor-compression refrigeration cycle.

• 1809 – Jacob Perkins patented the first refrigerating machine

• 1810 – John Leslie freezes water to ice by using an airpump.

• 1811 – Avogadro's law a gas law

• 1823 – Michael Faraday liquefied ammonia to cause cooling

• 1824 – Sadi Carnot – the Carnot Cycle

• 1834 – Ideal gas law by Émile Clapeyron

• 1834 – Émile Clapeyron characterizes phase transitions between two phases in form of Clausius–Clapeyron relation.

• 1834 – Jacob Perkins obtained the first patent for a vapor-compression refrigeration system.

• 1834 – Jean-Charles Peltier discovers the Peltier effect

• 1844 – Charles Piazzi Smyth proposes comfort cooling

• c.1850 – Michael Faraday makes a hypothesis that freezing substances increases their dielectric constant.
- 1851 – John Gorrie patented his mechanical refrigeration machine in the US to make ice to cool the air
- 1852 – James Prescott Joule and William Thomson, 1st Baron Kelvin discover Joule–Thomson effect
- 1856 – James Harrison patented an ether liquid-vapour compression refrigeration system and developed the first practical ice-making and refrigeration room for use in the brewing and meat-packing industries of Geelong, Victoria, Australia.
- 1856 – August Krönig simplistic foundation of kinetic theory of gases.
- 1857 – Rudolf Clausius creates a sophisticated theory of gases based including all degrees of freedom, as well derives Clausius–Clapeyron relation from basic principles.
- 1857 – Carl Wilhelm Siemens, the Siemens cycle
- 1858 – Julius Plücker observed for the first time some pumping effect due to electrical discharge.
- 1859 – James Clerk Maxwell determines distribution of velocities and kinetic energies in a gas, and explains emergent property of temperature and heat, and creates a first law of statistical mechanics.
- 1859 – Ferdinand Carré – The first gas absorption refrigeration system using gaseous ammonia dissolved in water (referred to as "aqua ammonia")
- 1862 – Alexander Carnegie Kirk invents the Air cycle machine
- 1864 – Charles Tellier patented a refrigeration system using dimethyl ether
- 1867 - Thaddeus S. C. Lowe patented a refrigeration system using carbon dioxide, and in 1869 made ice making machine using dry carbon dioxide. Same year Lowe put a compressor based refrigeration device on a bough steamship for transport of frozen meat.
- 1869 – Charles Tellier installed a cold storage plant in France.
- 1869 – Thomas Andrews discovers existence of a critical point in fluids.
- 1871 – Carl von Linde built his first ammonia compression machine.
- c.a. 1873 – Van der Waals publishes and proposes a real gas model named later a Van der Waals equation.
- 1875 - Raoul Pictet develops a refrigeration machine using sulphur dioxide to combat high-pressure problems of ammonia in when used in tropical climates (mainly for the purpose of shipping meat).
- 1876 – Carl von Linde patented equipment to liquefy air using the Joule Thomson expansion process and regenerative cooling
- 1877 – Raoul Pictet and Louis Paul Cailletet, working separately, develop two methods to liquify oxygen.
- 1879 – Bell-Coleman machine
- 1882 – William Soltau Davidson fitted a compression refrigeration unit to the New Zealand vessel Dunedin
- 1883 – Zygmunt Wróblewski condenses experimentally useful quantities of liquid oxygen
- 1885 – Zygmunt Wróblewski published hydrogen's critical temperature as 33 K; critical pressure, 13.3 atmospheres; and boiling point, 23 K.
- 1888 – Loftus Perkins develops the "Arktos" cold chamber for preserving food, using an early ammonia absorption system.
- 1892 – James Dewar invents the vacuum-insulated, silver-plated glass Dewar flask
- 1895 – Carl von Linde files for patent protection of the Hampson–Linde cycle for liquefaction of atmospheric air or other gases (approved in 1903).
- 1898 – James Dewar condenses liquid hydrogen by using regenerative cooling and his invention, the vacuum flask.
- 1905 – Carl von Linde obtains pure liquid oxygen and nitrogen.
- 1906 – Willis Carrier patents the basis for modern air conditioning.
- 1908 – Heike Kamerlingh Onnes liquefies helium.
- 1911 – Heike Kamerlingh Onnes discloses his research on metallic low-temperature phenomenon characterised by no electrical resistance, calling it superconductivity.
- 1915 – Wolfgang Gaede – the Diffusion pump
- 1922 – Baltzar von Platen and Carl Munters invent the 3 fluids absorption chiller, exclusively driven by heat.
- 1924 – Fernand Holweck – the Holweck pump
- 1926 – Albert Einstein and Leó Szilárd invent the Einstein refrigerator.
- 1926 – Willem Hendrik Keesom solidifies helium.
- 1926 – General Electric Company introduced the first hermetic compressor refrigerator
- 1929 - David Forbes Keith of Toronto, Ontario, Canada received a patent for the Icy Ball which helped hundreds of thousands of families through the Dirty Thirties.
- 1933 – William Giauque and others – Adiabatic demagnetization refrigeration
- 1937 – Pyotr Leonidovich Kapitsa, John F. Allen, and Don Misener discover superfluidity using helium-4 at 2.2 K
- 1937 – Frans Michel Penning invents a type of cold cathode vacuum gauge known as Penning gauge
- 1944 – Manne Siegbahn, the Siegbahn pump
- 1949 – S.G. Sydoriak, E.R. Grilly, E.F. Hammel, first measurements on pure 3He in the 1 K range
- 1951 – Heinz London invents the principle of the dilution refrigerator
- 1955 – Willi Becker turbomolecular pump concept
- 1956 – G.K. Walters, W.M. Fairbank, discovery of phase separation in 3He-4He mixtures
- 1957 – Lewis D. Hall, Robert L. Jepsen and John C. Helmer ion pump based on Penning discharge
- 1959 – Kleemenko cycle
- 1965 – D.O. Edwards, and others, discovery of finite solubility of 3He in 4He at 0K
- 1965 – P. Das, R. de Bruyn Ouboter, K.W. Taconis, one-shot dilution refrigerator
- 1972 – David Lee, Robert Coleman Richardson and Douglas Osheroff discover superfluidity in helium-3 at 0.002 K.
- 1973 – Linear compressor
- 1978 – Laser cooling demonstrated in the groups of Wineland and Dehmelt.
- 1983 – Orifice-type pulse tube refrigerator invented by Mikulin, Tarasov, and Shkrebyonock
- 1986 – Karl Alexander Müller and J. Georg Bednorz discover high-temperature superconductivity
- 1995 – Eric Cornell and Carl Wieman create the first Bose–Einstein condensate, using a dilute gas of Rubidium-87 cooled to 170 nK. They won the Nobel Prize for Physics in 2001 for BEC.
- 1999 – D.J. Cousins and others, dilution refrigerator reaching 1.75 mK
- 1999 - The current world record lowest temperature was set at 100 picokelvins (pK), or 0.000 000 000 1 of a kelvin, by cooling the nuclear spins in a piece of rhodium metal.
- 2000 - Nuclear spin temperatures below 100 pK were reported for an experiment at the Helsinki University of Technology's Low Temperature Lab in Espoo, Finland. However, this was the temperature of one particular degree of freedom – a quantum property called nuclear spin – not the overall average thermodynamic temperature for all possible degrees in freedom.
- 2014 - Scientists in the CUORE collaboration at the Laboratori Nazionali del Gran Sasso in Italy cooled a copper vessel with a volume of one cubic meter to 0.006 kelvins (~273.144 °C; ~459.659 °F) for 15 days, setting a record for the lowest temperature in the known universe over such a large contiguous volume
- 2015 - Experimental physicists at Massachusetts Institute of Technology (MIT) successfully cooled molecules in a gas of sodium potassium to a temperature of 500 nanokelvins, and it is expected to exhibit an exotic state of matter by cooling these molecules a bit further.
- 2017 - Cold Atom Laboratory (CAL), an experimental instrument being developed for launch to the International Space Station (ISS) in 2018. The instrument will create extremely cold conditions in the microgravity environment of the ISS leading to the formation of Bose Einstein Condensates that are a magnitude colder than those that are created in laboratories on Earth. In a space-based laboratory, up to 20 seconds interaction times and as low as 1 picokelvin (10 to the power of -12 K) temperatures are achievable, and it could lead to exploration of unknown quantum mechanical phenomena and test some of the most fundamental laws of physics.
## Timeline of hydrogen technologies

- **c. 1520** – First recorded observation of hydrogen by Paracelsus through dissolution of metals (iron, zinc, and tin) in sulfuric acid.
- **1625** – First description of hydrogen by Johann Baptista van Helmont. First to use the word "gas".
- **1650** – Turquet de Mayerne obtained a gas or "inflammable air" by the action of dilute sulphuric acid on iron.
- **1662** – Boyle's law (gas law relating pressure and volume)
- **1670** – Robert Boyle produced hydrogen by reacting metals with acid.
- **1672** – "New Experiments touching the Relation between Flame and Air" by Robert Boyle.
- **1679** – Denis Papin – safety valve
- **1700** – Nicolas Lemery showed that the gas produced in the sulfuric acid/iron reaction was explosive in air
- **1755** – Joseph Black confirmed that different gases exist. / Latent heat
- **1766** – Henry Cavendish published in *On Factitious Airs* a description of "dephlogisticated air" by reacting zinc metal with hydrochloric acid and isolated a gas 7 to 11 times lighter than air.
- **1774** – Joseph Priestley isolated and categorized oxygen.
- **1780** – Felice Fontana discovers the water-gas shift reaction
- **1783** – Antoine Lavoisier gave hydrogen its name (Gk: hydro = water, genes = born of)
- **1783** – Jacques Charles made the first flight with his hydrogen balloon "La Charlière".
- **1783** – Antoine Lavoisier and Pierre Laplace measured the heat of combustion of hydrogen using an ice calorimeter.
- **1784** – Jean-Pierre Blanchard, attempted a dirigible hydrogen balloon, but it would not steer.
- **1784** – The invention of the Lavoisier Meusnier iron-steam process, generating hydrogen by passing water vapor over a bed of red-hot iron at 600 °C.
- **1785** – Jean-François Pilâtre de Rozier built the hybrid Rozière balloon.
- **1787** – Charles's law (gas law, relating volume and temperature)
- **1789** – Jan Rudolph Deiman and Adriaan Paets van Troostwijk using an electrostatic machine and a Leyden jar for the first electrolysis of water.
- **1800** – William Nicholson and Anthony Carlisle decomposed water into hydrogen and oxygen by electrolysis with a voltaic pile.
- **1800** – Johann Wilhelm Ritter duplicated the experiment with a rearranged set of electrodes to collect the two gases separately.
- **1801** – Humphry Davy discovers the concept of the Fuel Cell.
1806 – François Isaac de Rivaz built the de Rivaz engine, the first internal combustion engine powered by a mixture of hydrogen and oxygen.

1809 – Thomas Forster observed with a theodolite the drift of small free pilot balloons filled with "inflammable gas".

1809 – Gay-Lussac's law (gas law, relating temperature and pressure).

1811 – Amedeo Avogadro – Avogadro's law a gas law.

1819 – Edward Daniel Clarke invented the hydrogen gas blowpipe.

1820 – W. Cecil wrote a letter "On the application of hydrogen gas to produce a moving power in machinery".

1823 – Goldsworthy Gurney demonstrated limelight.

1823 – Döbereiner's Lamp a lighter invented by Johann Wolfgang Döbereiner.

1823 – Goldsworthy Gurney devised an oxy-hydrogen blowpipe.

1824 – Michael Faraday invented the rubber balloon.

1826 – Thomas Drummond built the Drummond Light.

1826 – Samuel Brown tested his internal combustion engine by using it to propel a vehicle up Shooter's Hill.


1834 – Benoît Paul Émile Clapeyron – Ideal gas law.

1836 – John Frederic Daniell invented a primary cell in which hydrogen was eliminated in the generation of the electricity.

1839 – Christian Friedrich Schönbein published the principle of the fuel cell in the "Philosophical Magazine".

1839 – William Robert Grove developed the Grove cell.

1842 – William Robert Grove developed the first fuel cell (which he called the gas voltaic battery).

1849 – Eugène Bourdon – Bourdon gauge (manometer).

1863 – Etienne Lenoir made a test drive from Paris to Joinville-le-Pont with the 1-cylinder, 2-stroke Hippomobile.

1866 – August Wilhelm von Hofmann invents the Hofmann voltameter for the electrolysis of water.

1873 – Thaddeus S. C. Lowe – Water gas, the process used the water gas shift reaction.

1874 – Jules Verne – The Mysterious Island, "water will one day be employed as fuel, that hydrogen and oxygen of which it is constituted will be used".

1884 – Charles Renard and Arthur Constantin Krebs launch the airship La France.
• 1885 – Zygmunt Florenty Wróblewski published hydrogen’s critical temperature as 33 K; critical pressure, 13.3 atmospheres; and boiling point, 23 K.

• 1889 – Ludwig Mond and Carl Langer coined the name fuel cell and tried to build one running on air and Mond gas.

• 1893 – Friedrich Wilhelm Ostwald experimentally determined the interconnected roles of the various components of the fuel cell.

• 1895 – Hydrolysis

• 1896 – Jackson D.D. and Ellms J.W., hydrogen production by microalgae (Anabaena)

• 1896 – Leon Teisserenc de Bort carries out experiments with high flying instrumental weather balloons.

• 1897 – Paul Sabatier facilitated the use of hydrogenation with the discovery of the Sabatier reaction.

• 1898 – James Dewar liquefied hydrogen by using regenerative cooling and his invention, the vacuum flask at the Royal Institution of Great Britain in London.

• 1899 – James Dewar collected solid hydrogen for the first time.

• 1900 – Count Ferdinand von Zeppelin launched the first hydrogen-filled Zeppelin LZ1 airship.

• 1901 – Wilhelm Normann introduced the hydrogenation of fats.

• 1903 – Konstantin Eduardovich Tsiolkovskii published "The Exploration of Cosmic Space by Means of Reaction Devices"

• 1907 – Lane hydrogen producer

• 1909 – Count Ferdinand Adolf August von Zeppelin made the first long distance flight with the Zeppelin LZ5.

• 1909 – Linde–Frank–Caro process

• 1910 – The first Zeppelin passenger flight with the Zeppelin LZ7.

• 1910 – Fritz Haber patented the Haber process.

• 1912 – The first scheduled international Zeppelin passenger flights with the Zeppelin LZ13.

• 1913 – Niels Bohr explains the Rydberg formula for the spectrum of hydrogen by imposing a quantization condition on classical orbits of the electron in hydrogen

• 1919 – The first Atlantic crossing by airship with the Beardmore HMA R34.

• 1920 – Hydrocracking, a plant for the commercial hydrogenation of brown coal is commissioned at Leuna in Germany.

• 1923 – Steam reforming, the first synthetic methanol is produced by BASF in Leuna

• 1923 – J. B. S. Haldane envisioned in Daedalus; or, Science and the Future "great power stations where during windy weather the surplus power will be used for the electrolytic decomposition of water into oxygen and hydrogen."
• 1926 – Wolfgang Pauli and Erwin Schrödinger show that the Rydberg formula for the spectrum of hydrogen follows from the new quantum mechanics

• 1926 – Partial oxidation, Vandeveer and Parr at the University of Illinois used oxygen in the place of air for the production of syngas.

• 1926 – Cyril Norman Hinshelwood described the phenomenon of chain reaction.

• 1926 – Umberto Nobile made the first flight over the north pole with the hydrogen airship Norge

• 1929 – Paul Harteck and Karl Friedrich Bonhoeffer achieve the first synthesis of pure parahydrogen.

• 1930 – Rudolf Erren – Erren engine – GB patent GB364180 – Improvements in and relating to internal combustion engines using a mixture of hydrogen and oxygen as fuel


• 1937 – The Zeppelin LZ 129 Hindenburg was destroyed by fire.

• 1937 – The Heinkel HeS 1 experimental gaseous hydrogen fueled centrifugal jet engine is tested at Hirth in March- the first working jet engine

• 1937 – The first hydrogen-cooled turbogenerator went into service at Dayton, Ohio.

• 1938 – The first 240 km hydrogen pipeline Rhine-Ruhr.

• 1938 – Igor Sikorsky from Sikorsky Aircraft proposed liquid hydrogen as a fuel.


• 1939 – Hans Gaffron discovered that algae can switch between producing oxygen and hydrogen.

• 1941 – The first mass application of hydrogen in internal combustion engines: Russian lieutenant Boris Sheligshch in the besieged Leningrad has converted some hundreds cars "GAZ-AA" which served posts of barrage balloons of air defense.

• 1943 – Liquid hydrogen is tested as rocket fuel at Ohio State University.

• 1943 – Arne Zetterström describes hydrox

• 1947 – Willis Lamb and Robert Retherford measure the small energy shift (the Lamb shift) between the 2s1/2 and 2p1/2 levels of hydrogen, providing a great stimulus to the development of quantum electrodynamics

• 1949 – Hydrodesulfurization (Catalytic reforming is commercialized under the name Platforming process)

• 1951 – Underground hydrogen storage

• 1952 – Ivy Mike, the first successful test of a nuclear explosive based on hydrogen (actually, deuterium) fusion

• 1952 – Non-Refrigerated transport Dewar
1955 – W. Thomas Grubb modified the fuel cell design by using a sulphonated polystyrene ion-exchange membrane as the electrolyte.

1957 – Pratt & Whitney's model 304 jet engine using liquid hydrogen as fuel tested for the first time as part of the Lockheed CL-400 Suntan project.

1957 – The specifications for the U-2 a double axle liquid hydrogen semi-trailer were issued.

1958 – Leonard Niedrach devised a way of depositing platinum onto the membrane, this became known as the Grubb-Niedrach fuel cell

1958 – Allis-Chalmers demonstrated the D 12, the first 15 kW fuel cell tractor.

1959 – Francis Thomas Bacon built the Bacon Cell, the first practical 5 kW hydrogen-air fuel cell to power a welding machine.

1960 – Allis-Chalmers builds the first fuel cell forklift

1961 – RL-10 liquid hydrogen fuelled rocket engine first flight

1964 – Allis-Chalmers built a 750-watt fuel cell to power a one-man underwater research vessel.

1965 – The first commercial use of a fuel cell in Project Gemini.

1965 – Allis-Chalmers builds the first fuel cell golf carts.

1966 – General Motors presents Electrovan, the world's first fuel cell automobile.

1966 – Slush hydrogen

1966 – J-2 (rocket engine) liquid hydrogen rocket engine flies

1967 – Akira Fujishima discovers the Honda-Fujishima effect which is used for photocatalysis in the photoelectrochemical cell.

1967 – Hydride compressor

1970 – Nickel hydrogen battery

1970 – John Bockris or Lawrence W. Jones coined the term hydrogen economy

1973 – The 30 km hydrogen pipeline in Isbergues

1973 – Linear compressor


1979 – HM7B rocket engine

1981 – Space Shuttle Main Engine first flight


1996 – Vulcain rocket engine

1997 – Anastasios Melis discovered that the deprivation of sulfur will cause algae to switch from producing oxygen to producing hydrogen
- 1998 – Type 212 submarine
- 1999 – Hydrogen pinch
- 2000 – Peter Toennies demonstrates superfluidity of hydrogen at 0.15 K
- 2001 – The first type IV hydrogen tanks for compressed hydrogen at 700 bar (10000 PSI) were demonstrated.
- 2002 – Type 214 submarine
- 2002 – The first hydral locomotive was demonstrated in Val-d'Or, Quebec.
- 2004 – DeepC is an autonomous underwater vehicle propelled by an electric motor powered by a hydrogen fuel cell.
- 2005 – Ionic liquid piston compressor
- 2013 – The first commercial 2 megawatt power to gas installation in Falkenhagen comes online for 360 cubic meters of hydrogen per hour hydrogen storage into the natural gas grid.
- 2014 – The Japanese fuel cell micro combined heat and power (mCHP) ENE FARM project passes 100,000 sold systems.
- 2016 – Toyota releases its first hydrogen fuel cell car, the Mirai
- 2017 – Hydrogen Council formed to expedite development and commercialization of hydrogen and fuel cell technologies

**Timeline of temperature and pressure measurement technology**

- 1592–1593 — Galileo Galilei builds a device showing variation of hotness known as the thermoscope using the contraction of air to draw water up a tube.
- 1612 — Santorio Sanctorius makes the first thermometer for medical use
- 1617 — Giuseppe Biancani published the first clear diagram of a thermoscope
- 1624 — The word thermometer (in its French form) first appeared in La Récréation Mathématique by Jean Leurechon, who describes one with a scale of 8 degrees.
- 1629 — Joseph Solomon Delmedigo describes in a book an accurate sealed-glass thermometer that uses brandy
- 1638 — Robert Fludd the first thermoscope showing a scale and thus constituting a thermometer.
- 1643 — Evangelista Torricelli invents the mercury barometer
• 1654 — Ferdinando II de' Medici, Grand Duke of Tuscany, made sealed tubes part filled with alcohol, with a bulb and stem, the first modern-style thermometer, depending on the expansion of a liquid, and independent of air pressure

• 1695 — Guillaume Amontons improved the thermometer

• 1701 — Newton publishes a method of determining the rate of heat loss of a body and introduces a scale, which had 0 degrees represent the freezing point of water, and 12 degrees for human body temperature.

• 1701 — Ole Christensen Rømer made one of the first practical thermometers. As a temperature indicator it used red wine. (Rømer scale), The temperature scale used for his thermometer had 0 representing the temperature of a salt and ice mixture (at about 259s).

• 1709 — Daniel Gabriel Fahrenheit constructed alcohol thermometers which were reproducible (i.e. two would give the same temperature)

• 1714 — Daniel Gabriel Fahrenheit invents the mercury-in-glass thermometer giving much greater precision (4 x that of Rømer). Using Rømer's zero point and an upper point of blood temperature, he adjusted the scale so the melting point of ice was 32 and the upper point 96, meaning that the difference of 64 could be got by dividing the intervals into 2 repeatedly.

• 1731 — René Antoine Ferchault de Réaumur produced a scale in which 0 represented the freezing point of water and 80 represented the boiling point. This was chosen as his alcohol mixture expanded 80 parts per thousand. He did not consider pressure.

• 1738 — Daniel Bernoulli asserted in Hydrodynamica the principle that as the speed of a moving fluid increases, the pressure within the fluid decreases. (Kinetic theory)

• 1742 — Anders Celsius proposed a temperature scale in which 100 represented the temperature of melting ice and 0 represented the boiling point of water at a particular pressure.

• 1743 — Jean-Pierre Christin had worked independently of Celsius and developed a scale where zero represented the melting point of ice and 100 represented the boiling point but did not specify a pressure.

• 1744 — Carl Linnaeus suggested reversing the temperature scale of Anders Celsius so that 0 represented the freezing point of water and 100 represented the boiling point.

• 1782 — James Six invents the Maximum minimum thermometer

• 1821 — Thomas Johann Seebeck invents the thermocouple

• 1844 — Lucien Vidi invents the aneroid Barograph

• 1845 — Francis Ronalds invents the first successful Barograph based on photography

• 1848 — Lord Kelvin (William Thomson) – Kelvin scale, in his paper, On an Absolute Thermometric Scale

• 1849 — Eugène Bourdon – Bourdon gauge (manometer)

• 1849 — Henri Victor Regnault – Hypsometer
1864 — Henri Becquerel suggests an optical pyrometer
1866 — Thomas Clifford Allbutt invented a clinical thermometer that produced a body temperature reading in five minutes as opposed to twenty.
1871 — William Siemens describes the Resistance thermometer at the Bakerian Lecture
1874 — Herbert McLeod invents the McLeod gauge
1885 — Calender-Van Duesen invented the platinum resistance temperature device
1887 — Richard Assmann invents the psychrometer (Wet and Dry Bulb Thermometers)
1892 — Henri-Louis Le Châtelier builds the first optical pyrometer
1896 — Samuel Siegfried Karl Ritter von Basch introduced the Sphygmomanometer to measure blood pressure
1906 — Marcello Pirani – Pirani gauge (to measure pressures in vacuum systems)
1915 — J.C. Stevens — Chart recorder (first chart recorder for environmental monitoring)
1924 — Irving Langmuir — Langmuir probe (to measure plasma parameters)
1930 — Samuel Ruben invented the thermistor

Timeline of heat engine technology

- Prehistory - The fire piston used by tribes in southeast Asia and the Pacific islands to kindle fire.
- c. 450 BC - Archytas of Tarentum used a jet of steam to propel a toy wooden bird suspended on wire.
- c. 50 AD - Hero of Alexandria's Engine, also known as Aeolipile. Demonstrates rotary motion produced by the reaction from jets of steam.
- c. 10th century - China develops the earliest fire lances which were spear-like weapons combining a bamboo tube containing gunpowder and shrapnel like projectiles tied to a spear.
- c 12th century - China, the earliest depiction of a gun showing a metal body and a tight-fitting projectile which maximises the conversion of the hot gases to forward motion.
- 1125 - Gerbert, a professor in the schools at Rheims designed and built an organ blown by air escaping from a vessel in which it was compressed by heated water.
- 1232 - First recorded use of a rocket. In a battle between the Chinese and the Mongols.
- c. 1500 - Leonardo da Vinci builds the Architonnerre, a steam-powered cannon.
- 1543 - Blasco de Garay, a Spanish naval officer demonstrates a boat propelled without oars or sail that utilised the reaction from a jet issued from a large boiling kettle of water.
• 1551 - Taqi al-Din demonstrates a steam turbine, used to rotate a spit.
• 1629 - Giovanni Branca demonstrates a steam turbine.
• 1662 - Robert Boyle publishes Boyle's Law which defines the relationship between volume and pressure in a gas at a constant temperature.
• 1665 - Edward Somerset, the Second Marquess of Worcester builds a working steam fountain.
• 1680 - Christiaan Huygens publishes a design for a piston engine powered by gunpowder but it is never built.
• 1690 - Denis Papin - produces design for the first piston steam engine.
• 1698 - Thomas Savery builds a pistonless steam-powered water pump for pumping water out of mines.
• 1707 - Denis Papin - produces design for his second piston steam engine in conjunction with Gottfried Leibniz.
• 1712 - Thomas Newcomen builds the first commercially successful piston-and-cylinder steam-powered water pump for pumping water out of mines. It is known as an atmospheric engine and operates by condensing steam in a cylinder to produce a vacuum which moves the piston by atmospheric pressure.
• 1748 - William Cullen demonstrates the first artificial refrigeration in a public lecture at the University of Glasgow in Scotland.
• 1759 - John Harrison uses a bimetallic strip in his third marine chronometer (H3) to compensate for temperature-induced changes in the balance spring. This converts thermal expansion and contraction in two dissimilar solids to mechanical work.
• 1769 - James Watt patents his first improved atmospheric steam engine, see Watt steam engine with a separate condenser outside the cylinder, doubling the efficiency of earlier engines.
• 1787 - Jacques Charles formulates Charles's law which describes the relationship between gas's volume and temperature. He does not publish this however and it is not recognised until Joseph Louis Gay-Lussac develops and references it in 1802.
• 1791 - John Barber patents the idea of a gas turbine.
• 1799 - Richard Trevithick builds the first high pressure steam engine. This used the force from pressurized steam to move the piston.
• 1802 - Joseph Louis Gay-Lussac develops Gay-Lussac's law which describes the relationship between a gas's pressure and temperature.
• 1807 - Nicéphore Niépce installed his 'moss, coal-dust and resin' fuelled Pyréolophore internal combustion engine in a boat and powered up the river Saone in France.
• 1807 - Franco/Swiss engineer François Isaac de Rivaz built the De Rivaz engine, powered by the internal combustion of hydrogen and oxygen mixture and used it to power a wheeled vehicle.
- 1816 - Robert Stirling invented Stirling engine, a type of hot air engine.
- 1824 - Nicolas Léonard Sadi Carnot developed the Carnot cycle and the associated hypothetical Carnot heat engine that is the basic theoretical model for all heat engines. This gives the first early insight into the second law of thermodynamics.
- 1834 - Jacob Perkins, obtained the first patent for a vapor-compression refrigeration system.
- 1850s - Rudolf Clausius sets out the concept of the thermodynamic system and positioned entropy as being that in any irreversible process a small amount of heat energy $\delta Q$ is incrementally dissipated across the system boundary.
- 1859 - Etienne Lenoir developed the first commercially successful internal combustion engine, a single-cylinder, two-stroke engine with electric ignition of illumination gas (not gasoline).
- 1861 - Alphonse Beau de Rochas of France originates the concept of the four-stroke internal-combustion engine by emphasizing the previously unappreciated importance of compressing the fuel–air mixture before ignition.
- 1861 - Nikolaus Otto patents a two-stroke internal combustion engine building on Lenoir's.
- 1867 - James Clerk Maxwell postulated the thought experiment that later became known as Maxwell's demon. This appeared to violate the second law of thermodynamics and was the beginning of the idea that information was part of the physics of heat.
- 1872 - Pulsometer steam pump, a pistonless pump, patented by Charles Henry Hall. It was inspired by the Savery steam pump.
- 1873 - The British chemist Sir William Crookes invents the light mill a device which turns the radiant heat of light directly into rotary motion.
- 1877 - Theorist Ludwig Boltzmann visualized a probabilistic way to measure the entropy of an ensemble of ideal gas particles, in which he defined entropy to be proportional to the logarithm of the number of microstates such a gas could occupy.
- 1877 - Nikolaus Otto patents a practical four-stroke internal combustion engine
- 1883 - Samuel Griffin of Bath UK patents a six-stroke internal combustion engine.
- 1884 - Charles A. Parsons builds the first modern Steam turbine.
- 1886 - Herbert Akroyd Stuart builds the prototype Hot bulb engine, an oil fueled Homogeneous Charge Compression Ignition engine similar to the later diesel but with a lower compression ratio and running on a fuel air mixture.
- 1892 - Rudolf Diesel patents the Diesel engine (U.S. Patent 608,845) where a high compression ratio generates hot gas which then ignites an injected fuel. After five years of experimenting and assistance from MAN company, he builds a working diesel engine in 1897.
• 1909, the Dutch physicist Heike Kamerlingh Onnes develops the concept of enthalpy for the measure of the "useful" work that can be obtained from a closed thermodynamic system at a constant pressure.

• 1913 - Nikola Tesla patents the Tesla turbine based on the Boundary layer effect.

• 1926 - Robert Goddard of the USA launches the first liquid fuel rocket.

• 1929 - Felix Wankel patents the Wankel rotary engine (U.S. Patent 2,988,008)

• 1929 - Leó Szilárd, in a refinement of the famous Maxwell's demon scenario conceives of a heat engine that can run on information alone, known as the Szilard engine.

• 1930 - Sir Frank Whittle in England patents the first design for a gas turbine for jet propulsion.

• 1933 - French physicist Georges J. Ranque invents the Vortex tube, a fluid flow device without moving parts, that can separate a compressed gas into hot and cold streams.

• 1935 - Ralph H. Fowler invents the title 'the zeroth law of thermodynamics' to summarise postulates made by earlier physicists that, thermal equilibrium between systems is a transitive relation.

• 1937 - Hans von Ohain builds a gas turbine

• 1940 - Hungarian Bela Karlovitz working for the Westinghouse company in the USA files the first patent for a magnetohydrodynamic generator, which can generate electricity directly from a hot moving gas

• 1942 - R.S. Gaugler of General Motors patents the idea of the Heat pipe, a heat transfer mechanism that combines the principles of both thermal conductivity and phase transition to efficiently manage the transfer of heat between two solid interfaces.

• 1950s - The Philips company develop the Stirling-cycle Stirling Cryocooler which converts mechanical energy to a temperature difference.

• 1959 - Geusic, Schultz-DuBois and Scoville of Bell Telephone Laboratories USA build a Three Level Maser which runs as a quantum heat engine extracting work from the temperature difference of two heat pools.

• 1962 - William J. Buehler and Frederick Wang discover the Nickel titanium alloy known as Nitinol which has a shape memory dependent on its temperature.

• 1992 - The first practical magnetohydrodynamic generators are built in Serbia and the USA.

• 1996 - Quasiturbine engine patented

• 2011 - Shoichi Toyabe and others demonstrate a working Szilard engine using a phase-contrast microscope equipped with a high speed camera connected to a computer.

• 2011 - Michigan State University builds the first wave disk engine. An internal combustion engine which does away with pistons, crankshafts and valves, and replaces them with a disc-shaped shock wave generator.
2019 - A working quantum heat engine based on a spin-1/2 system and nuclear magnetic resonance techniques is demonstrated by Roberto Serra and others at the Universities of Waterloo, and the Universidade Federal do ABC and Centro Brasileiro de Pesquisas Físicas.

Timeline of clothing and textiles technology

- c. 27000 BC – Impressions of textiles and basketry and nets left on small pieces of hard clay in Europe.
- c. 25000 BC – Venus figurines depicted with clothing.
- c. 6000 BC – Evidence of woven textiles used to wrap the dead at Çatalhöyük in Anatolia.
- c. 5000 BC – Production of linen cloth in Ancient Egypt, along with other bast fibers including rush, reed, palm, and papyrus.
- c. 3000 BC – Breeding of domesticated sheep with a woolly fleece rather than hair in the Near East.
- c. 2500 BC – The Indus Valley Civilization cultivates cotton in the Indian subcontinent.
- c. 1000 BC - Cherchen Man was laid to rest with a twill tunic and the earliest known sample of tartan fabric.
- c. 200 AD – Earliest woodblock printing from China. Flowers in three colors on silk.
- 247 AD – Dura-Europos, a Roman outpost, is destroyed. Excavations of the city discovered early examples of naalebinding fabric.
- 1275 – Approximate date of a silk burial cushion knit in two colors found in the tomb of Spanish royalty.
- 1493 – The first available reference to lace is in a will by one of the ruling Milanese Sforza family.
- 1892 – Cross, Bevan & Beadle invent Viscose.
- 1938 – First commercial nylon fiber production by DuPont. Nylon is the first synthetic non-cellulosic fiber on the market.
- 1938 – First commercial PTFE fiber production by DuPont.
- 1953 – First commercial polyester PET fiber production by DuPont.
- 1964 – Kevlar fiber invented by DuPont's Stephanie Kwolek.
- c. 28000 BC – Sewing needles in use at Kostenki in Russia.
- c. 65000 BC – Approximately date of Naalebinding examples found in Nahal Hemar cave, Israel. This technique, which uses short separate lengths of thread, predated the invention of knitting (with its
continuous lengths of thread) and requires that all of the as-yet unused thread be pulled through the loop in the sewn material. This requires much greater skill than knitting in order to create a fine product.

- **4200 BC** – Date of Mesolithic examples of Naalebinding found in Denmark, marking spread of technology to Northern Europe.
- **200 BC to 200 AD** – Approximate date of earliest evidence of "Needle Knitting" in Peru, a form of Naalebinding that preceded local contact with the Spanish.
- **298 AD** – Earliest attestation of a foot-powered loom, with a hint that the invention arose at Tarsus.
- **500s** – Handheld roller cotton gins invented in the Indian subcontinent.
- **500-1000** – Spinning wheel invented in the Indian subcontinent.
- **1000s** – Finely decorated examples of cotton socks made by true knitting using continuous thread appear in Egypt.
- **1000s** – The earliest clear illustrations of the spinning wheel come from the Islamic world.
- **1100s-1300s** – Dual-roller cotton gins appear in India and China.
- **1200s-1300s** – The worm gear roller cotton gin invented in the Indian subcontinent during the early Delhi Sultanate era.
- **1400s-1500s** – The incorporation of the crank handle in the cotton gin, first appeared in the Indian subcontinent some time during the late Delhi Sultanate or the early Mughal Empire.
- **1562** – Date of first example of use of the purl stitch, from a tomb in Toledo, Spain, which allows knitting of panels of material. Previously material had to be knitted in the round (in a tubular form) and cut open.
- **1589** – William Lee invents stocking frame, the first but hand-operated weft knitting machine.
- **c. 1600** – The modern spinning wheel comes together with the addition of the treadle to the flyer wheel.
- **1725** – Basile Bouchon in Lyon invents punched paper data storage as a means for controlling a loom.
- **1733** – John Kay patents the flying shuttle.
- **1738** – Lewis Paul patents the draw roller.
- **1745** – Jacques Vaucanson in Lyon invents the first fully automated loom.
- **1758** – Jedediah Strutt adds a second set of needles to Lee's stocking frame thus creating the rib frame.
- **1764** – James Hargreaves or Thomas Highs invents the spinning jenny (patented 1770).
- **1767** – John Kay invents the spinning frame.
- **1768** – Josiah Crane invents the hand-operated warp knitting machine.
- **1769** – Richard Arkwright's water frame.
- **1769** – Samuel Wise solves the mechanization of W. Lee's stocking frame.
- **1779** – Samuel Crompton invents the spinning mule.
• 1784 – Edmund Cartwright invents the power loom.
• 1791 – The Englishman Dawson solves the mechanization of the warp knitting machine.
• 1793 – Samuel Slater of Belper establishes the first successful cotton spinning mill in the United States, at Pawtucket; beginnings of the "Rhode Island System"
• 1794 – Eli Whitney patents the cotton gin.
• 1798 – The Frenchman Decroix (or Decroise) patents the circular bearded needle knitting machine.
• 1801 – Joseph Marie Jacquard invents the Jacquard punched card loom.
• 1806 – Pierre Jeandeau patents the first latch needle (for using on knitting machine).
• 1808 – John Heathcoat patented the bobbin net machine
• 1812 – Samuel Clark and James Mart constructed the pusher machine
• 1813 – William Horrocks improves the power loom.
• 1814 – Paul Moody of the Boston Manufacturing Company builds the first power loom in the United States; beginnings of the "Waltham System"
• 1823 – Associates of the late Francis Cabot Lowell of the Boston Manufacturing Company begin operations at the Merrimack Manufacturing Company at East Chelmsford, Massachusetts. In 1826, East Chelmsford becomes incorporated as the town of Lowell, Massachusetts, the first factory city in the United States.
• 1828 – Paul Moody develops the leather belt and pulley power transmission system, which would become the standard for U.S. mills.
• 1830 – Barthélemy Thimonnier develops the first functional sewing machine.
• 1833 – Walter Hunt invents the lockstitch sewing machine but, dissatisfied with its function, does not patent it.
• 1842 – Lancashire Loom developed by Bullough and Kenworthy, a semi automatic Power loom.
• 1842 – John Greenough patents the first sewing machine in the United States.
• 1844 – John Smith of Salford granted a patent for a shuttleless rapier loom.
• 1846 – John Livesey adapts John Heathcoat's bobbinet machine into the curtain machine
• 1847 – William Mason Patents his "Mason self-acting" Mule.
• 1849 – Matthew Townsend patents the variant of latch needle which has been the most widely used needle in weft knitting machines.
• 1855 – Redgate combines a circular loom with a warp knitting machine
• 1856 – Thomas Jeacock of Leicester patented the tubular pipe compound needle.
- 1857 – Arthur Paget patents a multi-head knitting machine called "Paget-machine".
- 1859 – Wilhelm Barfuss improves on Redgates machine, called Raschel machines (named after the French actress Élisabeth Félice Rachel).
- 1864 – William Cotton patents the straight bar knitting machine named after him ("Cotton machine").
- 1865 – The American Isaac Wixom Lamb patents the flat knitting machine using latch needles.
- 1865 – Clay invents the double-headed latch needle which has enabled to create purl stitch knitting.
- 1866 – The American Mac Nary patents the circular knitting machine (with vertical needles) for fabrication of socks and stockings with heel and toe pouches.
- 1878 – Henry Griswold adds a second set of needles (horizontal needles) to the circular knitting machine enabling knitting of rib fabrics as cuff for socks.
- 1881 – Pierre Durand invents the tubular pipe compound needle.
- 1890s – Development of the Barmen machine
- 1889 – Northrop Loom: Draper Corporation, First automatic bobbin changing weaving loom placed in production. Over 700,000 would be sold worldwide.
- 1900 – Heinrich Stoll creates the flat bed purl knitting machine.
- 1910 – Spiers invents the circular bed purl knitting machine.
- c. 1920 – Hattersley loom developed by George Hattersley and Sons.
- 1924 – Celanese Corporation produces the first acetate fiber.
- 1939 – US passes Wool Products Labeling Act, requiring truthful labeling of wool products according to origin.
- 1940 – Spectrophotometer invented, with impact on commercial textile dye processes.
- 1942 – First patent for fabric Singe awarded in US.
- 1949 – Heinrich Mauersberger invents the sewing-knitting technique and his "Malimo" machine.
- 1955 – Research begins on multi-phase weft insertion. Successful examples will not exist until the 80s and late 90s.
- 1956 – Du Pont Introduces a process for spinning sheaf yarn, a precursor to air-jet spinning.
- c. 1960s. Existing machines become outfitted with computerized numeric control (CNC) systems, enabling more accurate and efficient actuation.
- 1963 – Open-end spinning developed in Czechoslovakia.
Timeline of women in library science

- 1890: Elizabeth Putnam Sohier and Anna Eliot Ticknor became the first women appointed to a United States state library agency--specifically, the Massachusetts Board of Library Commissioners.
1911: Theresa Elmendorf became the first woman elected president of the American Library Association.

1912: Lillian Helena Smith became the first trained children's librarian in Canada in 1912.

1923: Virginia Proctor Powell Florence became the first black woman in the United States to earn a degree in library science. She earned the degree (Bachelor of Library Science) from what is now part of the University of Pittsburgh.

1947: Freda Farrell Waldon became the first president of the Canadian Library Association, and thus, as she was female, its first female president.

1972: Zoia Horn, born in Ukraine, became the first United States librarian to be jailed for refusing to share information as a matter of conscience (and, as she was female, the first female United States librarian to do so.)

1973: Page Ackerman became University Librarian for the University of California, Los Angeles, and was the United States's first female librarian of a system as large and complex as UCLA's.

1993: Jennifer Tanfield became the first female Librarian of the House of Commons of the United Kingdom.

1999: Elisabeth Niggemann became the first female director general of the German National Library.

2000: Lynne Brindley was appointed as the first female chief executive of the British Library.

2002: Inez Lynn was appointed as the first female librarian in the London Library's history.

2004: Anjana Chattopadhyay became the first Director of National Medical Library, New Delhi, India.

2012: Sonia L'Heureux became the first female Parliamentary Librarian of Canada.

2016: Laurence Engel became the first female head of the French National Library.

2016: Carla Hayden became the first female Librarian of Congress.

Timeline of Artificial Intelligence

| Antiquity | Greek myths of Hephaestus and Pygmalion incorporated the idea of intelligent robots (such as Talos) and artificial beings (such as Galatea and Pandora).
<p>| Sacred mechanical statues built in Egypt and Greece were believed to be capable of wisdom and emotion. Hermes Trismegistus would write &quot;they have sensus and spiritus ... by discovering the true nature of the gods, man has been able to reproduce it.&quot; Mosaic law prohibits the use of automats in religion. |
| 10th century | Yan Shi presented King Mu of Zhou with mechanical men. |</p>
<table>
<thead>
<tr>
<th>BC</th>
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<tbody>
<tr>
<td>384 BC-322 BC</td>
<td>Aristotle described the syllogism, a method of formal, mechanical thought and theory of knowledge in The Organon.</td>
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<tr>
<td>1st century</td>
<td>Heron of Alexandria created mechanical men and other automatons.</td>
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<tr>
<td>260</td>
<td>Porphyry of Tyros wrote <em>Isagogê</em> which categorized knowledge and logic.</td>
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<tr>
<td>~800</td>
<td>Geber developed the Arabic alchemical theory of <em>Takwin</em>, the artificial creation of life in the laboratory, up to and including human life.</td>
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<td>1206</td>
<td>Al-Jazari created a programmable orchestra of mechanical human beings.</td>
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<tr>
<td>1275</td>
<td>Ramon Llull, Spanish theologian, invents the <em>Ars Magna</em>, a tool for combining concepts mechanically, based on an Arabic astrological tool, the Zairja. The method would be developed further by Gottfried Leibniz in the 17th century.</td>
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<tr>
<td>~1500</td>
<td>Paracelsus claimed to have created an artificial man out of magnetism, sperm and alchemy.</td>
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<tr>
<td>~1580</td>
<td>Rabbi Judah Loew ben Bezalel of Prague is said to have invented the Golem, a clay man brought to life.</td>
</tr>
<tr>
<td>Early 17th century</td>
<td>René Descartes proposed that bodies of animals are nothing more than complex machines (but that mental phenomena are of a different &quot;substance&quot;).</td>
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<tr>
<td>1620</td>
<td>Sir Francis Bacon developed empirical theory of knowledge and introduced inductive logic in his work The New Organon, a play on Aristotle's title The Organon.</td>
</tr>
<tr>
<td>1623</td>
<td>Wilhelm Schickard drew a calculating clock on a letter to Kepler. This will be the first of five unsuccessful attempts at designing a direct entry calculating clock in the 17th century (including the designs of Tito Burattini, Samuel Morland and René Grillet).</td>
</tr>
<tr>
<td>1641</td>
<td>Thomas Hobbes published <em>Leviathan</em> and presented a mechanical, combinatorial theory of cognition. He wrote &quot;...for reason is nothing but reckoning&quot;.</td>
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<tr>
<td>1642</td>
<td>Blaise Pascal invented the mechanical calculator, the first digital calculating machine.</td>
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<tr>
<td>1672</td>
<td>Gottfried Leibniz improved the earlier machines, making the Stepped Reckoner to do multiplication and division. He also invented the binary numeral system and envisioned a universal calculus of reasoning (alphabet of human thought) by which arguments could be decided mechanically. Leibniz worked on assigning a specific number to each and every object in the world, as a prelude to an algebraic solution to all possible problems.</td>
</tr>
</tbody>
</table>
| 1726       | Jonathan Swift published *Gulliver's Travels*, which includes this description of the Engine, a machine on the island of Laputa: "a Project for improving speculative Knowledge by practical and mechanical Operations " by using this "Contrivance", "the most ignorant Person at a reasonable Charge, and with a little bodily Labour, may write Books in Philosophy, Poetry, Politicks, Law, Mathematicks,
and Theology, with the least Assistance from Genius or study." The machine is a parody of *Ars Magna*, one of the inspirations of Gottfried Leibniz' mechanism.

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>1750</td>
<td>Julien Offray de La Mettrie published <em>L'Homme Machine</em>, which argued that human thought is strictly mechanical.</td>
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<td>1769</td>
<td>Wolfgang von Kempelen built and toured with his chess-playing automaton, The Turk. The Turk was later shown to be a hoax, involving a human chess player.</td>
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<tr>
<td>1818</td>
<td>Mary Shelley published the story of <em>Frankenstein; or the Modern Prometheus</em>, a fictional consideration of the ethics of creating sentient beings.</td>
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<tr>
<td>1822–1859</td>
<td>Charles Babbage and Ada Lovelace worked on programmable mechanical calculating machines.</td>
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<tr>
<td>1837</td>
<td>The mathematician Bernard Bolzano made the first modern attempt to formalize semantics.</td>
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<tr>
<td>1854</td>
<td>George Boole set out to &quot;investigate the fundamental laws of those operations of the mind by which reasoning is performed, to give expression to them in the symbolic language of a calculus&quot;, inventing Boolean algebra.</td>
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<tr>
<td>1863</td>
<td>Samuel Butler suggested that Darwinian evolution also applies to machines, and speculates that they will one day become conscious and eventually supplant humanity.</td>
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<tr>
<td>1913</td>
<td>Bertrand Russell and Alfred North Whitehead published <em>Principia Mathematica</em>, which revolutionized formal logic.</td>
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<tr>
<td>1915</td>
<td>Leonardo Torres y Quevedo built a chess automaton, El Ajedrecista, and published speculation about thinking and automata.</td>
</tr>
<tr>
<td>1923</td>
<td>Karel Čapek's play <em>R.U.R. (Rossum's Universal Robots)</em> opened in London. This is the first use of the word &quot;robot&quot; in English.</td>
</tr>
<tr>
<td>1920s and 1930s</td>
<td>Ludwig Wittgenstein and Rudolf Carnap led philosophy into logical analysis of knowledge. Alonzo Church developed Lambda Calculus to investigate computability using recursive functional notation.</td>
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<tr>
<td>1931</td>
<td>Kurt Gödel showed that sufficiently powerful formal systems, if consistent, permit the formulation of true theorems that are unprovable by any theorem-proving machine deriving all possible theorems from the axioms. To do this he had to build a universal, integer-based programming language, which is the reason why he is sometimes called the &quot;father of theoretical computer science&quot;.</td>
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<tr>
<td>1940</td>
<td>Edward Condon displays Nimatron, a digital computer that played Nim perfectly.</td>
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<tr>
<td>1941</td>
<td>Konrad Zuse built the first working program-controlled computers.</td>
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<tr>
<td>1945</td>
<td>Game theory which would prove invaluable in the progress of AI was introduced with the 1944 paper, <em>Theory of Games and Economic</em></td>
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</tbody>
</table>
Behavior by mathematician John von Neumann and economist Oskar Morgenstern.

Vannevar Bush published *As We May Think* (The Atlantic Monthly, July 1945) a prescient vision of the future in which computers assist humans in many activities.

### 1948

John von Neumann (quoted by E.T. Jaynes) in response to a comment at a lecture that it was impossible for a machine to think: "You insist that there is something a machine cannot do. If you will tell me precisely what it is that a machine cannot do, then I can always make a machine which will do just that!". Von Neumann was presumably alluding to the Church-Turing thesis which states that any effective procedure can be simulated by a (generalized) computer.

### 1950

Alan Turing proposes the Turing Test as a measure of machine intelligence.

Claude Shannon published a detailed analysis of chess playing as search.

Isaac Asimov published his Three Laws of Robotics.

### 1951

The first working AI programs were written in 1951 to run on the Ferranti Mark 1 machine of the University of Manchester: a checkers-playing program written by Christopher Strachey and a chess-playing program written by Dietrich Prinz.

### 1952–1962

Arthur Samuel (IBM) wrote the first game-playing program, for checkers (draughts), to achieve sufficient skill to challenge a respectable amateur. His first checkers-playing program was written in 1952, and in 1955 he created a version that learned to play.

### 1956

The Dartmouth College summer AI conference is organized by John McCarthy, Marvin Minsky, Nathan Rochester of IBM and Claude Shannon. McCarthy coins the term *artificial intelligence* for the conference.

The first demonstration of the Logic Theorist (LT) written by Allen Newell, J.C. Shaw and Herbert A. Simon (Carnegie Institute of Technology, now Carnegie Mellon University or CMU). This is often called the first AI program, though Samuel's checkers program also has a strong claim.

### 1958

John McCarthy (Massachusetts Institute of Technology or MIT) invented the Lisp programming language.

Herbert Gelernter and Nathan Rochester (IBM) described a theorem prover in geometry that exploits a semantic model of the domain in the form of diagrams of "typical" cases.

Teddington Conference on the Mechanization of Thought Processes was held in the UK and among the papers presented were John McCarthy’s *Programs with Common Sense*, Oliver Selfridge’s *Pandemonium*, and Marvin Minsky’s *Some Methods of Heuristic Programming and Artificial Intelligence*.

### 1959

The General Problem Solver (GPS) was created by Newell, Shaw and Simon while at CMU.

John McCarthy and Marvin Minsky founded the MIT AI Lab.

### Late

Margaret Masterman and colleagues at University of Cambridge design semantic
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<thead>
<tr>
<th>Year</th>
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<tbody>
<tr>
<td>1950s, early 1960s</td>
<td>nets for machine translation.</td>
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<tr>
<td>1960s</td>
<td>Ray Solomonoff lays the foundations of a mathematical theory of AI, introducing universal Bayesian methods for inductive inference and prediction.</td>
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<td>1960</td>
<td><em>Man-Computer Symbiosis</em> by J.C.R. Licklider.</td>
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<tr>
<td>1961</td>
<td>James Slagle (PhD dissertation, MIT) wrote (in Lisp) the first symbolic integration program, SAINT, which solved calculus problems at the college freshman level.</td>
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<td></td>
<td>In <em>Minds, Machines and Gödel</em>, John Lucas denied the possibility of machine intelligence on logical or philosophical grounds. He referred to Kurt Gödel's result of 1931: sufficiently powerful formal systems are either inconsistent or allow for formulating true theorems unprovable by any theorem-proving AI deriving all provable theorems from the axioms. Since humans are able to &quot;see&quot; the truth of such theorems, machines were deemed inferior.</td>
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<td>Unimation's industrial robot Unimate worked on a General Motors automobile assembly line.</td>
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<td>1961</td>
<td>Thomas Evans' program, ANALOGY, written as part of his PhD work at MIT, demonstrated that computers can solve the same analogy problems as are given on IQ tests.</td>
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<td></td>
<td>Edward Feigenbaum and Julian Feldman published <em>Computers and Thought</em>, the first collection of articles about artificial intelligence.</td>
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<td></td>
<td>Leonard Uhr and Charles Vossler published &quot;A Pattern Recognition Program That Generates, Evaluates, and Adjusts Its Own Operators&quot;, which described one of the first machine learning programs that could adaptively acquire and modify features and thereby overcome the limitations of simple perceptrons of Rosenblatt.</td>
</tr>
<tr>
<td>1963</td>
<td>Danny Bobrow's dissertation at MIT (technical report #1 from MIT's AI group, Project MAC), shows that computers can understand natural language well enough to solve algebra word problems correctly.</td>
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<td></td>
<td>Bertram Raphael's MIT dissertation on the SIR program demonstrates the power of a logical representation of knowledge for question-answering systems.</td>
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<td>1965</td>
<td>Lotfi Zadeh at U.C. Berkeley publishes his first paper introducing fuzzy logic &quot;Fuzzy Sets&quot; <em>(Information and Control 8: 338–353).</em></td>
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<tr>
<td></td>
<td>J. Alan Robinson invented a mechanical proof procedure, the Resolution Method, which allowed programs to work efficiently with formal logic as a representation language.</td>
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<tr>
<td></td>
<td>Joseph Weizenbaum (MIT) built ELIZA, an interactive program that carries on a dialogue in English language on any topic. It was a popular toy at AI centers on the ARPANET when a version that &quot;simulated&quot; the dialogue of a psychotherapist was programmed.</td>
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</table>
Edward Feigenbaum initiated Dendral, a ten-year effort to develop software to deduce the molecular structure of organic compounds using scientific instrument data. It was the first expert system.

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<tr>
<td>1966</td>
<td>Ross Quillian (PhD dissertation, Carnegie Inst. of Technology, now CMU) demonstrated semantic nets.</td>
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<td></td>
<td>Machine Intelligence workshop at Edinburgh – the first of an influential annual series organized by Donald Michie and others.</td>
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<td></td>
<td>Negative report on machine translation kills much work in Natural language processing (NLP) for many years.</td>
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<tr>
<td></td>
<td>Dendral program (Edward Feigenbaum, Joshua Lederberg, Bruce Buchanan, Georgia Sutherland at Stanford University) demonstrated to interpret mass spectra on organic chemical compounds. First successful knowledge-based program for scientific reasoning.</td>
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<tr>
<td>1968</td>
<td>Joel Moses (PhD work at MIT) demonstrated the power of symbolic reasoning for integration problems in the Macsyma program. First successful knowledge-based program in mathematics.</td>
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<td></td>
<td>Richard Greenblatt (programmer) at MIT built a knowledge-based chess-playing program, MacHack, that was good enough to achieve a class-C rating in tournament play.</td>
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<td></td>
<td>Wallace and Boulton's program, Snob (Comp.J. 11(2) 1968), for unsupervised classification (clustering) uses the Bayesian Minimum Message Length criterion, a mathematical realisation of Occam’s razor.</td>
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<tr>
<td></td>
<td>Roger Schank (Stanford) defined conceptual dependency model for natural language understanding. Later developed (in PhD dissertations at Yale University) for use in story understanding by Robert Wilensky and Wendy Lehnert, and for use in understanding memory by Janet Kuldner.</td>
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<tr>
<td></td>
<td>Yorick Wilks (Stanford) developed the semantic coherence view of language called Preference Semantics, embodied in the first semantics-driven machine translation program, and the basis of many PhD dissertations since such as Bran Boguraev and David Carter at Cambridge.</td>
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<td></td>
<td>First International Joint Conference on Artificial Intelligence (IJCAI) held at Stanford.</td>
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<td></td>
<td>Marvin Minsky and Seymour Papert publish <em>Perceptrons</em>, demonstrating previously unrecognized limits of this feed-forward two-layered structure, and This book is considered by some to mark the beginning of the AI winter of the 1970s, a failure of confidence and funding for AI. Nevertheless, significant progress in the field continued (see below).</td>
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</table>
|      | McCarthy and Hayes started the discussion about the frame problem with their essay, "Some Philosophical Problems from the Standpoint of Artificial
<table>
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<tr>
<th>Year</th>
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</table>
| 1970 | Seppo Linnainmaa publishes the reverse mode of automatic differentiation. This method became later known as backpropagation, and is heavily used to train artificial neural networks.  
Jaime Carbonell (Sr.) developed SCHOLAR, an interactive program for computer assisted instruction based on semantic nets as the representation of knowledge.  
Bill Woods described Augmented Transition Networks (ATN's) as a representation for natural language understanding.  
Patrick Winston's PhD program, ARCH, at MIT learned concepts from examples in the world of children's blocks. |
| 1971 | Terry Winograd's PhD thesis (MIT) demonstrated the ability of computers to understand English sentences in a restricted world of children's blocks, in a coupling of his language understanding program, SHRDLU, with a robot arm that carried out instructions typed in English.  
Work on the Boyer-Moore theorem prover started in Edinburgh. |
| 1972 | Prolog programming language developed by Alain Colmerauer.  
Earl Sacerdoti developed one of the first hierarchical planning programs, ABSTRIPS. |
| 1973 | The Assembly Robotics Group at University of Edinburgh builds Freddy Robot, capable of using visual perception to locate and assemble models.  
(Edinburgh Freddy Assembly Robot: a versatile computer-controlled assembly system.)  
The Lighthill report gives a largely negative verdict on AI research in Great Britain and forms the basis for the decision by the British government to discontinue support for AI research in all but two universities. |
| 1974 | Ted Shortliffe's PhD dissertation on the MYCIN program (Stanford) demonstrated a very practical rule-based approach to medical diagnoses, even in the presence of uncertainty. While it borrowed from DENDRAL, its own contributions strongly influenced the future of expert system development, especially commercial systems. |
| 1975 | Earl Sacerdoti developed techniques of partial-order planning in his NOAH system, replacing the previous paradigm of search among state space descriptions. NOAH was applied at SRI International to interactively diagnose and repair electromechanical systems.  
Austin Tate developed the Nonlin hierarchical planning system able to search a space of partial plans characterised as alternative approaches to the underlying goal structure of the plan.  
Marvin Minsky published his widely read and influential article on Frames as a representation of knowledge, in which many ideas about schemas and semantic... |
<table>
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<tr>
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<tbody>
<tr>
<td>1970s</td>
<td>The Meta-Dendral learning program produced new results in chemistry (some rules of mass spectrometry) the first scientific discoveries by a computer to be published in a refereed journal. Barbara Grosz (SRI) established limits to traditional AI approaches to discourse modeling. Subsequent work by Grosz, Bonnie Webber and Candace Sidner developed the notion of &quot;centering&quot;, used in establishing focus of discourse and anaphoric references in Natural language processing. David Marr and MIT colleagues describe the &quot;primal sketch&quot; and its role in visual perception.</td>
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<tr>
<td>1976</td>
<td>Douglas Lenat's AM program (Stanford PhD dissertation) demonstrated the discovery model (loosely guided search for interesting conjectures). Randall Davis demonstrated the power of meta-level reasoning in his PhD dissertation at Stanford.</td>
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<tr>
<td>1978</td>
<td>Tom Mitchell, at Stanford, invented the concept of Version spaces for describing the search space of a concept formation program. Herbert A. Simon wins the Nobel Prize in Economics for his theory of bounded rationality, one of the cornerstones of AI known as &quot;satisficing&quot;. The MOLGEN program, written at Stanford by Mark Stefik and Peter Friedland, demonstrated that an object-oriented programming representation of knowledge can be used to plan gene-cloning experiments.</td>
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<tr>
<td>1979</td>
<td>Bill VanMelle's PhD dissertation at Stanford demonstrated the generality of MYCIN's representation of knowledge and style of reasoning in his EMYCIN program, the model for many commercial expert system &quot;shells&quot;. Jack Myers and Harry Pople at University of Pittsburgh developed INTERNIST, a knowledge-based medical diagnosis program based on Dr. Myers' clinical knowledge. Cordell Green, David Barstow, Elaine Kant and others at Stanford demonstrated the CHI system for automatic programming. The Stanford Cart, built by Hans Moravec, becomes the first computer-controlled, autonomous vehicle when it successfully traverses a chair-filled room and circumnavigates the Stanford AI Lab. BKG, a backgammon program written by Hans Berliner at CMU, defeats the reigning world champion (in part via luck). Drew McDermott and Jon Doyle at MIT, and John McCarthy at Stanford begin publishing work on non-monotonic logics and formal aspects of truth maintenance.</td>
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<tr>
<td>Late 1970s</td>
<td>Stanford's SUMEX-AIM resource, headed by Ed Feigenbaum and Joshua Lederberg, demonstrates the power of the ARPAnet for scientific collaboration.</td>
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<td>1980s</td>
<td>Lisp machines developed and marketed. First expert system shells and commercial applications.</td>
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<td>Year</td>
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<tr>
<td>1980</td>
<td>First National Conference of the American Association for Artificial Intelligence (AAAI) held at Stanford.</td>
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<tr>
<td>1981</td>
<td>Danny Hillis designs the connection machine, which utilizes Parallel computing to bring new power to AI, and to computation in general. (Later founds Thinking Machines Corporation)</td>
</tr>
<tr>
<td>1982</td>
<td>The Fifth Generation Computer Systems project (FGCS), an initiative by Japan's Ministry of International Trade and Industry, begun in 1982, to create a &quot;fifth generation computer&quot; (see history of computing hardware) which was supposed to perform much calculation utilizing massive parallelism.</td>
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<tr>
<td>1983</td>
<td>John Laird and Paul Rosenbloom, working with Allen Newell, complete CMU dissertations on Soar (program).</td>
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<td>Mid-1980s</td>
<td>Neural Networks become widely used with the Backpropagation algorithm, also known as the reverse mode of automatic differentiation published by Seppo Linnainmaa in 1970 and applied to neural networks by Paul Werbos.</td>
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<tr>
<td>1985</td>
<td>The autonomous drawing program, AARON, created by Harold Cohen, is demonstrated at the AAAI National Conference (based on more than a decade of work, and with subsequent work showing major developments).</td>
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<tr>
<td>1986</td>
<td>The team of Ernst Dickmanns at Bundeswehr University of Munich builds the first robot cars, driving up to 55 mph on empty streets.</td>
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<td></td>
<td>Barbara Grosz and Candace Sidner create the first computation model of discourse, establishing the field of research.</td>
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<tr>
<td>1987</td>
<td>Marvin Minsky published <em>The Society of Mind</em>, a theoretical description of the mind as a collection of cooperating agents. He had been lecturing on the idea for years before the book came out (c.f. Doyle 1983).</td>
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<td></td>
<td>Around the same time, Rodney Brooks introduced the subsumption architecture and behavior-based robotics as a more minimalist modular model of natural intelligence; Nouvelle AI.</td>
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<tr>
<td></td>
<td>Commercial launch of generation 2.0 of Alacrity by Alacritous Inc./Allstar Advice Inc. Toronto, the first commercial strategic and managerial advisory system. The system was based upon a forward-chaining, self-developed expert system with 3,000 rules about the evolution of markets and competitive strategies and co-authored by Alistair Davidson and Mary Chung, founders of the firm with the underlying engine developed by Paul Tarvydas. The Alacrity system also included a small financial expert system that interpreted financial statements and models.</td>
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<tr>
<td>1989</td>
<td>The development of metal–oxide–semiconductor (MOS) very-large-scale integration (VLSI), in the form of complementary MOS (CMOS) technology, enabled the development of practical artificial neural network (ANN) technology in the 1980s. A landmark publication in the field was the 1989 book <em>Analog VLSI Implementation of Neural Systems</em> by Carver A. Mead and Mohammed Ismail.</td>
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<tr>
<td>Year</td>
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<tr>
<td>1990s</td>
<td>Dean Pomerleau at CMU creates ALVINN (An Autonomous Land Vehicle in a Neural Network).</td>
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<tr>
<td>1990s</td>
<td>Major advances in all areas of AI, with significant demonstrations in machine learning, intelligent tutoring, case-based reasoning, multi-agent planning, scheduling, uncertain reasoning, data mining, natural language understanding and translation, vision, virtual reality, games, and other topics.</td>
</tr>
<tr>
<td>Early 1990s</td>
<td>TD-Gammon, a backgammon program written by Gerry Tesauro, demonstrates that reinforcement (learning) is powerful enough to create a championship-level game-playing program by competing favorably with world-class players.</td>
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<tr>
<td>1991</td>
<td>DART scheduling application deployed in the first Gulf War paid back DARPA's investment of 30 years in AI research.</td>
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<tr>
<td>1992</td>
<td>Carol Stoker and NASA Ames robotics team explore marine life in Antarctica with an undersea robot Telepresence ROV operated from the ice near McMurdo Bay, Antarctica and remotely via satellite link from Moffett Field, California.</td>
</tr>
<tr>
<td>1993</td>
<td>Ian Horswill extended behavior-based robotics by creating Polly, the first robot to navigate using vision and operate at animal-like speeds (1 meter/second). Rodney Brooks, Lynn Andrea Stein and Cynthia Breazeal started the widely publicized MIT Cog project with numerous collaborators, in an attempt to build a humanoid robot child in just five years. ISX corporation wins &quot;DARPA contractor of the year&quot; for the Dynamic Analysis and Replanning Tool (DART) which reportedly repaid the US government's entire investment in AI research since the 1950s.</td>
</tr>
<tr>
<td>1994</td>
<td>Lotfi Zadeh at U.C. Berkeley creates &quot;soft computing&quot; and builds a world network of research with a fusion of neural science and neural net systems, fuzzy set theory and fuzzy systems, evolutionary algorithms, genetic programming, and chaos theory and chaotic systems (&quot;Fuzzy Logic, Neural Networks, and Soft Computing,&quot; Communications of the ACM, March 1994, Vol. 37 No. 3, pages 77-84). With passengers on board, the twin robot cars VaMP and VITA-2 of Ernst Dickmanns and Daimler-Benz drive more than one thousand kilometers on a Paris three-lane highway in standard heavy traffic at speeds up to 130 km/h. They demonstrate autonomous driving in free lanes, convoy driving, and lane changes left and right with autonomous passing of other cars. English draughts (checkers) world champion Tinsley resigned a match against computer program Chinook. Chinook defeated 2nd highest rated player, Lafferty. Chinook won the USA National Tournament by the widest margin ever. Cindy Mason at NASA organizes the First AAAI Workshop on AI and the Environment.</td>
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</table>
the United States with computer-controlled steering for 2,797 miles (4,501 km) of the 2,849 miles (4,585 km). Throttle and brakes were controlled by a human driver.

One of Ernst Dickmanns’ robot cars (with robot-controlled throttle and brakes) drove more than 1000 miles from Munich to Copenhagen and back, in traffic, at up to 120 mph, occasionally executing maneuvers to pass other cars (only in a few critical situations a safety driver took over). Active vision was used to deal with rapidly changing street scenes.

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<td>1997</td>
<td>The Deep Blue chess machine (IBM) defeats the (then) world chess champion, Garry Kasparov.</td>
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<td>First official RoboCup football (soccer) match featuring table-top matches with 40 teams of interacting robots and over 5000 spectators.</td>
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<td></td>
<td>Computer Othello program Logistello defeated the world champion Takeshi Murakami with a score of 6–0.</td>
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<td>1998</td>
<td>Tiger Electronics’ Furby is released, and becomes the first successful attempt at producing a type of A.I to reach a domestic environment.</td>
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<td>Tim Berners-Lee published his Semantic Web Road map paper.</td>
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<td></td>
<td>Ulises Cortés and Miquel Sànchez-Marrè organize the first Environment and AI Workshop in Europe ECAI, &quot;Binding Environmental Sciences and Artificial Intelligence.&quot;</td>
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<td></td>
<td>Leslie P. Kaelbling, Michael Littman, and Anthony Cassandra introduce POMDPs and a scalable method for solving them to the AI community, jumpstarting widespread use in robotics and automated planning and scheduling.</td>
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<tr>
<td>1999</td>
<td>Sony introduces an improved domestic robot similar to a Furby, the AIBO becomes one of the first artificially intelligent &quot;pets&quot; that is also autonomous.</td>
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<tr>
<td>Late 1990s</td>
<td>Web crawlers and other AI-based information extraction programs become essential in widespread use of the World Wide Web.</td>
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<td></td>
<td>Demonstration of an Intelligent room and Emotional Agents at MIT’s AI Lab.</td>
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<td>Initiation of work on the Oxygen architecture, which connects mobile and stationary computers in an adaptive network.</td>
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<td>2000</td>
<td>Interactive robopets (&quot;smart toys&quot;) become commercially available, realizing the vision of the 18th century novelty toy makers.</td>
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<td></td>
<td>Cynthia Breazeal at MIT publishes her dissertation on Sociable machines, describing Kismet (robot), with a face that expresses emotions.</td>
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<td>The Nomad robot explores remote regions of Antarctica looking for meteorite samples.</td>
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<td>2002</td>
<td>iRobot’s Roomba autonomously vacuums the floor while navigating and avoiding obstacles.</td>
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<td>DARPA introduces the DARPA Grand Challenge requiring competitors to produce</td>
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<tr>
<td>Year</td>
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<tr>
<td>2005</td>
<td>Honda’s ASIMO robot, an artificially intelligent humanoid robot, is able to walk as fast as a human, delivering trays to customers in restaurant settings. Recommendation technology based on tracking web activity or media usage brings AI to marketing. See TiVo Suggestions. Blue Brain is born, a project to simulate the brain at molecular detail.</td>
</tr>
<tr>
<td>2006</td>
<td>The Dartmouth Artificial Intelligence Conference: The Next 50 Years (AI@50) AI@50 (14–16 July 2006)</td>
</tr>
<tr>
<td>2007</td>
<td>Philosophical Transactions of the Royal Society, B – Biology, one of the world's oldest scientific journals, puts out a special issue on using AI to understand biological intelligence, titled Models of Natural Action Selection. Checkers is solved by a team of researchers at the University of Alberta. DARPA launches the Urban Challenge for autonomous cars to obey traffic rules and operate in an urban environment.</td>
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<tr>
<td>2008</td>
<td>Cynthia Mason at Stanford presents her idea on Artificial Compassionate Intelligence, in her paper on “Giving Robots Compassion”.</td>
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<tr>
<td>2009</td>
<td>Google builds autonomous car.</td>
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<tr>
<td>2010</td>
<td>Microsoft launched Kinect for Xbox 360, the first gaming device to track human body movement, using just a 3D camera and infra-red detection, enabling users to play their Xbox 360 wirelessly. The award-winning machine learning for human motion capture technology for this device was developed by the Computer Vision group at Microsoft Research, Cambridge.</td>
</tr>
<tr>
<td>2011</td>
<td>Mary Lou Maher and Doug Fisher organize the First AAAI Workshop on AI and Sustainability. IBM’s Watson computer defeated television game show Jeopardy! champions Rutter and Jennings.</td>
</tr>
<tr>
<td>2013</td>
<td>Robot HRP-2 built by SCHAFT Inc of Japan, a subsidiary of Google, defeats 15 teams to win DARPA’s Robotics Challenge Trials. HRP-2 scored 27 out of 32 points in 8 tasks needed in disaster response. Tasks are drive a vehicle, walk over debris, climb a ladder, remove debris, walk through doors, cut through a wall, close valves and connect a hose. NEIL, the Never Ending Image Learner, is released at Carnegie Mellon University to constantly compare and analyze relationships between different images.</td>
</tr>
<tr>
<td>2015</td>
<td>An open letter to ban development and use of autonomous weapons signed by Hawking, Musk, Wozniak and 3,000 researchers in AI and robotics.</td>
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<td>Date</td>
<td>Event</td>
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<tr>
<td>2016</td>
<td>Google DeepMind's AlphaGo (version: Lee) defeated Lee Sedol 4–1. Lee Sedol is a 9 dan professional Korean Go champion who won 27 major tournaments from 2002 to 2016. Before the match with AlphaGo, Lee Sedol was confident in predicting an easy 5–0 or 4–1 victory.</td>
</tr>
<tr>
<td>2016</td>
<td>Asilomar Conference on Beneficial AI was held, to discuss AI ethics and how to bring about beneficial AI while avoiding the existential risk from artificial general intelligence.</td>
</tr>
<tr>
<td>2017</td>
<td>Deepstack is the first published algorithm to beat human players in imperfect information games, as shown with statistical significance on heads-up no-limit poker. Soon after, the poker AI Libratus by different research group individually defeated each of its 4 human opponents—among the best players in the world—at an exceptionally high aggregated winrate, over a statistically significant sample. In contrast to Chess and Go, Poker is an imperfect information game.</td>
</tr>
<tr>
<td>2017</td>
<td>Google DeepMind's AlphaGo (version: Master) won 60–0 rounds on two public Go websites including 3 wins against world Go champion Ke Jie.</td>
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<tr>
<td>2017</td>
<td>A propositional logic boolean satisfiability problem (SAT) solver proves a long-standing mathematical conjecture on Pythagorean triples over the set of integers. The initial proof, 200TB long, was checked by two independent certified automatic proof checkers.</td>
</tr>
<tr>
<td>2017</td>
<td>An OpenAI-machined learned bot played at The International 2017 Dota 2 tournament in August 2017. It won during a 1v1 demonstration game against professional Dota 2 player Dendi.</td>
</tr>
<tr>
<td>2017</td>
<td>Google DeepMind revealed that AlphaGo Zero—an improved version of AlphaGo—displayed significant performance gains while using far fewer tensor processing units (as compared to AlphaGo Lee; it used same amount of TPU's as AlphaGo Master). Unlike previous versions, which learned the game by observing millions of human moves, AlphaGo Zero learned by playing only against itself. The system then defeated AlphaGo Lee 100 games to zero, and defeated AlphaGo Master 89 to 11. Although unsupervised learning is a step forward, much has yet to be learned about general intelligence. AlphaZero masters chess in 4 hours, defeating the best chess engine, StockFish 8. AlphaZero won 28 out of 100 games, and the remaining 72 games ended in a draw.</td>
</tr>
<tr>
<td>2018</td>
<td>Alibaba language processing AI outscores top humans at a Stanford University reading and comprehension test, scoring 82.44 against 82.304 on a set of 100,000 questions.</td>
</tr>
<tr>
<td>2018</td>
<td>The European Lab for Learning and Intelligent Systems (aka Ellis) proposed as a pan-European competitor to American AI efforts, with the aim of staving off a brain drain of talent, along the lines of CERN after World War II.</td>
</tr>
</tbody>
</table>
Announcement of Google Duplex, a service to allow an AI assistant to book appointments over the phone. The LA Times judges the AI's voice to be a "nearly flawless" imitation of human-sounding speech.

Timeline of machine learning

<table>
<thead>
<tr>
<th>Year</th>
<th>Event type</th>
<th>Caption</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1763</td>
<td>Discovery</td>
<td>The Underpinnings of Bayes' Theorem</td>
<td>Thomas Bayes's work <em>An Essay towards solving a Problem in the Doctrine of Chances</em> is published two years after his death, having been amended and edited by a friend of Bayes, Richard Price. The essay presents work which underpins Bayes theorem.</td>
</tr>
<tr>
<td>1805</td>
<td>Discovery</td>
<td>Least Square</td>
<td>Adrien-Marie Legendre describes the &quot;méthode des moindres carrés&quot;, known in English as the least squares method. The least squares method is used widely in data fitting.</td>
</tr>
<tr>
<td>1812</td>
<td></td>
<td>Bayes' Theorem</td>
<td>Pierre-Simon Laplace publishes <em>Théorie Analytique des Probabilités</em>, in which he expands upon the work of Bayes and defines what is now known as Bayes' Theorem.</td>
</tr>
<tr>
<td>1913</td>
<td>Discovery</td>
<td>Markov Chains</td>
<td>Andrey Markov first describes techniques he used to analyse a poem. The techniques later become known as Markov chains.</td>
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<tr>
<td>1950</td>
<td></td>
<td>Turing's Learning Machine</td>
<td>Alan Turing proposes a 'learning machine' that could learn and become artificially intelligent. Turing's specific proposal foreshadows genetic algorithms.</td>
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<tr>
<td>1951</td>
<td></td>
<td>First Neural Network Machine</td>
<td>Marvin Minsky and Dean Edmonds build the first neural network machine, able to learn, the SNARC.</td>
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<tr>
<td>1952</td>
<td></td>
<td>Machines Playing Checkers</td>
<td>Arthur Samuel joins IBM's Poughkeepsie Laboratory and begins working on some of the very first machine learning programs, first creating programs that play checkers.</td>
</tr>
<tr>
<td>1957</td>
<td>Discovery</td>
<td>Perceptron</td>
<td>Frank Rosenblatt invents the perceptron while working at the Cornell Aeronautical Laboratory. The invention of the perceptron generated a great deal of excitement and was</td>
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<tr>
<td>Year</td>
<td>Event/Invention</td>
<td>Details</td>
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<tr>
<td>1963</td>
<td>Machines Playing Tic-Tac-Toe</td>
<td>Donald Michie creates a 'machine' consisting of 304 match boxes and beads, which uses reinforcement learning to play Tic-tac-toe (also known as noughts and crosses).</td>
<td></td>
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<tr>
<td>1967</td>
<td>Nearest Neighbor</td>
<td>The nearest neighbor algorithm was created, which is the start of basic pattern recognition. The algorithm was used to map routes.</td>
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<tr>
<td>1969</td>
<td>Limitations of Neural Networks</td>
<td>Marvin Minsky and Seymour Papert publish their book <em>Perceptrons</em>, describing some of the limitations of perceptrons and neural networks. The interpretation that the book shows that neural networks are fundamentally limited is seen as a hindrance for research into neural networks.</td>
<td></td>
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<tr>
<td>1970</td>
<td>Automatic Differentiation (Backpropagation)</td>
<td>Seppo Linnainmaa publishes the general method for automatic differentiation (AD) of discrete connected networks of nested differentiable functions. This corresponds to the modern version of backpropagation, but is not yet named as such.</td>
<td></td>
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<tr>
<td>1979</td>
<td>Stanford Cart</td>
<td>Students at Stanford University develop a cart that can navigate and avoid obstacles in a room.</td>
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<tr>
<td>1979</td>
<td>Neocognitron</td>
<td>Kunihiko Fukushima first publishes his work on the neocognitron, a type of artificial neural network (ANN). Neocognition later inspires convolutional neural networks (CNNs).</td>
<td></td>
</tr>
<tr>
<td>1981</td>
<td>Explanation Based Learning</td>
<td>Gerald Dejong introduces Explanation Based Learning, where a computer algorithm analyses data and creates a general rule it can follow and discard unimportant data.</td>
<td></td>
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<tr>
<td>1982</td>
<td>Recurrent Neural Network</td>
<td>John Hopfield popularizes Hopfield networks, a type of recurrent neural network that can serve as content-addressable memory systems.</td>
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<tr>
<td>1985</td>
<td>NetTalk</td>
<td>A program that learns to pronounce words the same way a baby does, is developed by Terry Sejnowski.</td>
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<tr>
<td>1986</td>
<td>Backpropagation</td>
<td>Seppo Linnainmaa's reverse mode of automatic differentiation (first applied to neural networks by Paul Werbos) is used in experiments by David Rumelhart, Geoff Hinton and Ronald J. Williams to learn internal representations.</td>
<td></td>
</tr>
<tr>
<td>1989</td>
<td>Reinforcement</td>
<td>Christopher Watkins develops Q-learning, which</td>
<td></td>
</tr>
</tbody>
</table>
Learning greatly improves the practicality and feasibility of reinforcement learning.

1989 Commercialization Commercialization of Machine Learning on Personal Computers
Axcelis, Inc. releases Evolver, the first software package to commercialize the use of genetic algorithms on personal computers.

1992 Achievement Machines Playing Backgammon
Gerald Tesauro develops TD-Gammon, a computer backgammon program that uses an artificial neural network trained using temporal-difference learning (hence the 'TD' in the name). TD-Gammon is able to rival, but not consistently surpass, the abilities of top human backgammon players.

1995 Discovery Random Forest Algorithm
Tin Kam Ho publishes a paper describing random decision forests.

1995 Discovery Support Vector Machines
Corinna Cortes and Vladimir Vapnik publish their work on support vector machines.

1997 Achievement IBM Deep Blue Beats Kasparov
IBM's Deep Blue beats the world champion at chess.

1997 Discovery LSTM

1998 Discovery MNIST database
A team led by Yann LeCun releases the MNIST database, a dataset comprising a mix of handwritten digits from American Census Bureau employees and American high school students. The MNIST database has since become a benchmark for evaluating handwriting recognition.

2002 Discovery Torch Machine Learning Library
Torch, a software library for machine learning, is first released.

2006 Discovery The Netflix Prize
The Netflix Prize competition is launched by Netflix. The aim of the competition was to use machine learning to beat Netflix's own recommendation software's accuracy in predicting a user's rating for a film given their ratings for previous films by at least 10%. The prize was won in 2009.

2009 Discovery ImageNet
ImageNet is created. ImageNet is a large visual database envisioned by Fei-Fei Li from Stanford University, who realized that the best machine
learning algorithms wouldn’t work well if the data didn’t reflect the real world. For many, ImageNet was the catalyst for the AI boom of the 21st century.

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>Kaggle Competition</td>
<td>Kaggle, a website that serves as a platform for machine learning competitions, is launched.</td>
</tr>
<tr>
<td>2010</td>
<td>Wall Street Journal Profiles Machine Learning Investing</td>
<td>The WSJ Profiles new wave of investing and focuses on RebellionResearch.com which would be the subject of author Scott Patterson's Novel, Dark Pools.</td>
</tr>
<tr>
<td>2011</td>
<td>Achievement</td>
<td>Beating Humans in Jeopardy</td>
</tr>
<tr>
<td>2011</td>
<td>Achievement</td>
<td>Using a combination of machine learning, natural language processing and information retrieval techniques, IBM's Watson beats two human champions in a Jeopardy! competition.</td>
</tr>
<tr>
<td>2012</td>
<td>Achievement</td>
<td>Recognizing Cats on YouTube</td>
</tr>
<tr>
<td>2012</td>
<td>Achievement</td>
<td>The Google Brain team, led by Andrew Ng and Jeff Dean, create a neural network that learns to recognize cats by watching unlabeled images taken from frames of YouTube videos.</td>
</tr>
<tr>
<td>2014</td>
<td>Achievement</td>
<td>Leap in Face Recognition</td>
</tr>
<tr>
<td>2014</td>
<td></td>
<td>Facebook researchers publish their work on DeepFace, a system that uses neural networks that identifies faces with 97.35% accuracy. The results are an improvement of more than 27% over previous systems and rivals human performance.</td>
</tr>
<tr>
<td>2014</td>
<td>Sibyl</td>
<td>Researchers from Google detail their work on Sibyl, a proprietary platform for massively parallel machine learning used internally by Google to make predictions about user behavior and provide recommendations.</td>
</tr>
<tr>
<td>2016</td>
<td>Achievement</td>
<td>Beating Humans in Go</td>
</tr>
<tr>
<td>2016</td>
<td></td>
<td>Google's AlphaGo program becomes the first Computer Go program to beat an unhandicapped professional human player using a combination of machine learning and tree search techniques. Later improved as AlphaGo Zero and then in 2017 generalized to Chess and more two-player games with AlphaZero.</td>
</tr>
</tbody>
</table>
Timeline of biology and organic chemistry

Before 1600

- c. 520 BC – Alcmaeon of Croton distinguished veins from arteries and discovered the optic nerve.
- c. 450 BC – Sushruta wrote the *Sushruta Samhita*, redacted versions of which, by the third century AD, describe over 120 surgical instruments and 300 surgical procedures, classify human surgery into eight categories, and introduce cosmetic surgery.
- c. 450 BC – Xenophanes examined fossils and speculated on the evolution of life.
- c. 380 BC – Diocles wrote the oldest known anatomy book and was the first to use the term *anatomy*.
- c. 350 BC – Aristotle attempted a comprehensive classification of animals. His written works include *Historion Animalium*, a general biology of animals, *De Partibus Animalium*, a comparative anatomy and physiology of animals, and *De Generatione Animalium*, on developmental biology.
- c. 300 BC – Theophrastos (or Theophrastus) began the systematic study of botany.
- c. 300 BC – Herophilos dissected the human body.
- c. 50–70 AD – *Historia Naturalis* by Pliny the Elder (Gaius Plinius Secundus) was published in 37 volumes.
- 130–200 – Claudius Galen wrote numerous treatises on human anatomy.
- c. 1010 – Avicenna (Abu Ali al Hussein ibn Abdallah ibn Sina) published *The Canon of Medicine*.
- 1543 – Andreas Vesalius publishes the anatomy treatise *De humani corporis fabrica*.

1600–99

- 1620s – Jan Baptist van Helmont performed his famous tree plant experiment in which he shows that the substance of a plant derives from water, a forerunner of the discovery of photosynthesis.
- 1628 – William Harvey published *An Anatomical Exercise on the Motion of the Heart and Blood in Animals*
- 1651 – William Harvey concluded that all animals, including mammals, develop from eggs, and spontaneous generation of any animal from mud or excrement was an impossibility.
- 1665 – Robert Hooke saw cells in cork using a microscope.
- In 1661, 1664 and 1665, the blood cells were discerned by Marcello Malpighi. In 1678, the red blood corpuscles was described by Jan Swammerdam of Amsterdam, a Dutch naturalist and physician. The first
complete account of the red cells was made by Anthony van Leeuwenhoek of Delft in the last quarter of the 17th century.

- 1668 – Francesco Redi disproved spontaneous generation by showing that fly maggots only appear on pieces of meat in jars if the jars are open to the air. Jars covered with cheesecloth contained no flies.
- 1672 – Marcello Malpighi published the first description of chick development, including the formation of muscle somites, circulation, and nervous system.
- 1676 – Anton van Leeuwenhoek observed protozoa and calls them animalcules.
- 1677 – Anton van Leeuwenhoek observed spermatozoa.
- 1683 – Anton van Leeuwenhoek observed bacteria. Leeuwenhoek's discoveries renew the question of spontaneous generation in microorganisms.

1700–99

- 1767 – Kaspar Friedrich Wolff argued that the tissues of a developing chick form from nothing and are not simply elaborations of already-present structures in the egg.
- 1768 – Lazzaro Spallanzani again disproved spontaneous generation by showing that no organisms grow in a rich broth if it is first heated (to kill any organisms) and allowed to cool in a stoppered flask. He also showed that fertilization in mammals requires an egg and semen.
- 1771 – Joseph Priestley demonstrated that plants produce a gas that animals and flames consume. Those two gases are carbon dioxide and oxygen.

1800–99

- 1801 – Jean-Baptiste Lamarck began the detailed study of invertebrate taxonomy.
- 1802 – The term biology in its modern sense was propounded independently by Gottfried Reinhold Treviranus (*Biologie oder Philosophie der lebenden Natur*) and Lamarck (*Hydrogéologie*). The word was coined in 1800 by Karl Friedrich Burdach.
- 1809 – Lamarck proposed a modern theory of evolution based on the inheritance of acquired characteristics.
- 1820 – Christian Friedrich Nasse formulated Nasse's law: hemophilia occurs only in males and is passed on by unaffected females.
• 1824 – J. L Prevost and J. B. Dumas showed that the sperm in semen were not parasites, as previously thought, but, instead, the agents of fertilization.

• 1826 – Karl von Baer showed that the eggs of mammals are in the ovaries, ending a 200-year search for the mammalian egg.

• 1828 – Friedrich Woehler synthesized urea; first synthesis of an organic compound from inorganic starting materials.

• 1836 – Theodor Schwann discovered pepsin in extracts from the stomach lining; first isolation of an animal enzyme.

• 1837 – Theodor Schwann showed that heating air will prevent it from causing putrefaction.

• 1838 – Matthias Schleiden proposed that all plants are composed of cells.

• 1839 – Theodor Schwann proposed that all animal tissues are composed of cells. Schwann and Schleiden argued that cells are the elementary particles of life.

• 1843 – Martin Barry reported the fusion of a sperm and an egg for rabbits in a 1-page paper in the Philosophical Transactions of the Royal Society of London.

• 1856 – Louis Pasteur stated that microorganisms produce fermentation.

• 1858 – Charles R. Darwin and Alfred Wallace independently proposed a theory of biological evolution ("descent through modification") by means of natural selection. Only in later editions of his works did Darwin used the term "evolution."

• 1858 – Rudolf Virchow proposed that cells can only arise from pre-existing cells; "Omnis cellula e celulla," all cell from cells. The Cell Theory states that all organisms are composed of cells (Schleiden and Schwann), and cells can only come from other cells (Virchow).

• 1864 – Louis Pasteur disproved the spontaneous generation of cellular life.

• 1865 – Gregor Mendel demonstrated in pea plants that inheritance follows definite rules. The Principle of Segregation states that each organism has two genes per trait, which segregate when the organism makes eggs or sperm. The Principle of Independent Assortment states that each gene in a pair is distributed independently during the formation of eggs or sperm. Mendel's trailblazing foundation for the science of genetics went unnoticed, to his lasting disappointment.

• 1865 – Friedrich August Kekulé von Stradonitz realized that benzene is composed of carbon and hydrogen atoms in a hexagonal ring.

• 1869 – Friedrich Miescher discovered nucleic acids in the nuclei of cells.

• 1874 – Jacobus van ’t Hoff and Joseph-Achille Le Bel advanced a three-dimensional stereochemical representation of organic molecules and propose a tetrahedral carbon atom.

• 1876 – Oskar Hertwig and Hermann Fol independently described (in sea urchin eggs) the entry of sperm into the egg and the subsequent fusion of the egg and sperm nuclei to form a single new nucleus.
• 1884 – Emil Fischer began his detailed analysis of the compositions and structures of sugars.
• 1892 – Hans Driesch separated the individual cells of a 2-cell sea urchin embryo and shows that each cell develops into a complete individual, thus disproving the theory of preformation and showing that each cell is "totipotent," containing all the hereditary information necessary to form an individual.
• 1898 – Martinus Beijerinck used filtering experiments to show that tobacco mosaic disease is caused by something smaller than a bacterium, which he names a virus.

1900–49

• 1900 – Hugo de Vries, Carl Correns and Erich von Tschemmack independently rediscovered Mendel's paper on heredity.
• 1902 – Walter Sutton and Theodor Boveri, independently proposed that the chromosomes carry the hereditary information.
• 1905 – William Bateson coined the term "genetics" to describe the study of biological inheritance.
• 1906 – Mikhail Tsvet discovered the chromatography technique for organic compound separation.
• 1907 – Ivan Pavlov demonstrated conditioned responses with salivating dogs.
• 1907 – Hermann Emil Fischer artificially synthesized peptide amino acid chains and thereby shows that amino acids in proteins are connected by amino group-acid group bonds.
• 1909 – Wilhelm Johannsen coined the word "gene."
• 1911 – Thomas Hunt Morgan proposed that genes are arranged in a line on the chromosomes.
• 1922 – Aleksandr Oparin proposed that the Earth's early atmosphere contained methane, ammonia, hydrogen, and water vapor, and that these were the raw materials for the origin of life.
• 1926 – James B. Sumner showed that the urease enzyme is a protein.
• 1928 – Otto Diels and Kurt Alder discovered the Diels-Alder cycloaddition reaction for forming ring molecules.
• 1928 – Alexander Fleming discovered the first antibiotic, penicillin
• 1929 – Phoebus Levene discovered the sugar deoxyribose in nucleic acids.
• 1929 – Edward Doisy and Adolf Butenandt independently discovered estrone.
• 1930 – John Howard Northrop showed that the pepsin enzyme is a protein.
• 1931 – Adolf Butenandt discovered androsterone.
• 1932 – Hans Adolf Krebs discovered the urea cycle.
• 1933 – Tadeus Reichstein artificially synthesized vitamin C; first vitamin synthesis.
• 1935 – Rudolf Schoenheimer used deuterium as a tracer to examine the fat storage system of rats.
1935 – Wendell Stanley crystallized the tobacco mosaic virus.
1935 – Konrad Lorenz described the imprinting behavior of young birds.
1937 – Dorothy Crowfoot Hodgkin discovered the three-dimensional structure of cholesterol.
1937 – Hans Adolf Krebs discovered the tricarboxylic acid cycle.
1937 – In Genetics and the Origin of Species, Theodosius Dobzhansky applies the chromosome theory and population genetics to natural populations in the first mature work of neo-Darwinism, also called the modern synthesis, a term coined by Julian Huxley.
1938 – Marjorie Courtenay-Latimer discovered a living coelacanth off the coast of southern Africa.
1940 – Donald Griffin and Robert Galambos announced their discovery of echolocation by bats.
1942 – Max Delbrück and Salvador Luria demonstrated that bacterial resistance to virus infection is caused by random mutation and not adaptive change.
1944 – Oswald Avery shows that DNA carried the hereditary information in pneumococcus bacteria.
1945 – Dorothy Crowfoot Hodgkin discovered the three-dimensional structure of penicillin.
1948 – Erwin Chargaff showed that in DNA the number of guanine units equals the number of cytosine units and the number of adenine units equals the number of thymine units.

1950–89

1951 – The research group of Robert Robinson with John Cornforth (Oxford University) publishes their synthesis of cholesterol, while Robert Woodward (Harvard University) publishes his synthesis of cortisone.
1951 – Fred Sanger, Hans Tuppy, and Ted Thompson completed their chromatographic analysis of the insulin amino acid sequence.
1952 – American developmental biologists Robert Briggs and Thomas King cloned the first vertebrate by transplanting nuclei from leopard frogs embryos into enucleated eggs. More differentiated cells were the less able they are to direct development in the enucleated egg.
1952 – Alfred Hershey and Martha Chase showed that DNA is the genetic material in bacteriophage viruses.
1952 – Rosalind Franklin concluded that DNA is a double helix with a diameter of 2 nm and the sugar-phosphate backbones on the outside of the helix, based on x ray diffraction studies. She suspected the two sugar-phosphate backbones have a peculiar relationship to each other.
1953 – After examining Franklin's unpublished data, James D. Watson and Francis Crick published a double-helix structure for DNA, with one sugar-phosphate backbone running in the opposite direction to the other. They further suggested a mechanism by which the molecule can replicate itself and serve to
transmit genetic information. Their paper, combined with the Hershey-Chase experiment and Chargaff's data on nucleotides, finally persuaded biologists that DNA is the genetic material, not protein.

- 1953 – Stanley Miller showed that amino acids can be formed when simulated lightning is passed through vessels containing water, methane, ammonia, and hydrogen
- 1954 – Dorothy Crowfoot Hodgkin discovered the three-dimensional structure of vitamin B₁₂.
- 1955 – Marianne Grunberg-Manago and Severo Ochoa discovered the first nucleic-acid-synthesizing enzyme (polynucleotide phosphorylase), which links nucleotides together into polynucleotides.
- 1958 – John Gurdon used nuclear transplantation to clone an African Clawed Frog; first cloning of a vertebrate using a nucleus from a fully differentiated adult cell.
- 1958 – Matthew Stanley Meselson and Franklin W. Stahl proved that DNA replication is semiconservative in the Meselson-Stahl experiment
- 1959 – Max Perutz comes up with a model for the structure of oxygenated hemoglobin.
- 1959 – Severo Ochoa and Arthur Kornberg received the Nobel Prize for their work.
- 1960 – John Kendrew described the structure of myoglobin, the oxygen-carrying protein in muscle.
- 1960 – Four separate researchers (S. Weiss, J. Hurwitz, Audrey Stevens and J. Bonner) discovered bacterial RNA polymerase, which polymerizes nucleotides under the direction of DNA.
- 1961 – J. Heinrich Matthaei cracked the first codon of the genetic code (the codon for the amino acid phenylalanine) using Grunberg-Manago's 1955 enzyme system for making polynucleotides.
- 1961 – Joan Oró found that concentrated solutions of ammonium cyanide in water can produce the nucleotide adenine, a discovery that opened the way for theories on the origin of life.
- 1962 – Max Perutz and John Kendrew shared the Nobel prize for their work on the structure of hemoglobin and myoglobin.
- 1966 – Genetic code fully cracked through trial-and-error experimental work.
- 1966 – Kimishige Ishizaka discovered a new type of immunoglobulin, IgE, that develops allergy and explains the mechanisms of allergy at molecular and cellular levels.
- 1966 – Lynn Margulis proposed the endosymbiotic theory, that the eukaryotic cell is a symbiotic union of primitive prokaryotic cells. Richard Dawkins called the theory "one of the great achievements of twentieth-century evolutionary biology."
- 1968 – Fred Sanger used radioactive phosphorus as a tracer to chromatographically decipher a 120 base long RNA sequence.
- 1969 – Dorothy Crowfoot Hodgkin deciphered the three-dimensional structure of insulin.
• 1970 – Hamilton Smith and Daniel Nathans discovered DNA restriction enzymes.
• 1970 – Howard Temin and David Baltimore independently discovered reverse transcriptase enzymes.
• 1972 – Albert Eschenmoser and Robert Woodward synthesized vitamin B\textsubscript{12}.
• 1972 – Stephen Jay Gould and Niles Eldredge proposed an idea they call "punctuated equilibrium", which states that the fossil record is an accurate depiction of the pace of evolution, with long periods of "stasis" (little change) punctuated by brief periods of rapid change and species formation (within a lineage).
• 1972 – Seymour Jonathan Singer and Garth L. Nicholson developed the fluid mosaic model, which deals with the make-up of the membrane of all cells.
• 1974 – Manfred Eigen and Manfred Sumper showed that mixtures of nucleotide monomers and RNA replicase will give rise to RNA molecules which replicate, mutate, and evolve.
• 1974 – Leslie Orgel showed that RNA can replicate without RNA-replicase and that zinc aids this replication.
• 1977 – John Corliss and ten coauthors discovered chemosynthetically based animal communities located around submarine hydrothermal vents on the Galapagos Rift.
• 1977 – Walter Gilbert and Allan Maxam present a rapid DNA sequencing technique which uses cloning, base destroying chemicals, and gel electrophoresis.
• 1977 – Frederick Sanger and Alan Coulson presented a rapid gene sequencing technique which uses dideoxynucleotides and gel electrophoresis.
• 1978 – Frederick Sanger presented the 5,386 base sequence for the virus PhiX174; first sequencing of an entire genome.
• 1982 – Stanley B. Prusiner proposed the existence of infectious proteins, or prions. His idea is widely derided in the scientific community, but he wins a Nobel Prize in 1997.
• 1983 – Kary Mullis invented "PCR" (polymerase chain reaction), an automated method for rapidly copying sequences of DNA.
• 1984 – Alec Jeffreys devised a genetic fingerprinting method.
• 1986 – Alexander Klibanov demonstrated that enzymes can function in non-aqueous environments.
• 1986 – Rita Levi-Montalcini and Stanley Cohen received the Nobel Prize in Physiology or Medicine for their discovery of Nerve growth factor (NGF).

1990–present

• 1990 – French Anderson et al. performed the first approved gene therapy on a human patient
1990 – Napoli, Lemieux and Jorgensen discovered RNA interference (1990) during experiments aimed at the color of petunias.

1990 – Wolfgang Krätschmer, Lowell Lamb, Konstantinos Fostiropoulos, and Donald Huffman discovered that Buckminsterfullerene can be separated from soot because it is soluble in benzene.

1995 – Publication of the first complete genome of a free-living organism.

1996 – Dolly the sheep was first clone of an adult mammal.

1999 – Researchers at the Institute for Human Gene Therapy at the University of Pennsylvania accidentally kill Jesse Gelsinger during a clinical trial of a gene therapy technique, leading the FDA to halt further gene therapy trials at the Institute.

2001 – Publication of the first drafts of the complete human genome (see Craig Venter).

2002 – First virus produced 'from scratch', an artificial polio virus that paralyzes and kills mice.

Timeline of computer viruses and worms

Pre-1970

- John von Neumann's article on the "Theory of self-reproducing automata" is published in 1966. The article is based on lectures given by von Neumann at the University of Illinois about the "Theory and Organization of Complicated Automata" in 1949.

1971–1975

1970 (Fiction)

- The first story written about a computer virus is The Scarred Man by Gregory Benford.

1971

- The Creeper system, an experimental self-replicating program, is written by Bob Thomas at BBN Technologies to test John von Neumann's theory. Creeper infected DEC PDP-10 computers running the TENEX operating system. Creeper gained access via the ARPANET and copied itself to the remote system where the message "I'm the creeper, catch me if you can!" was displayed. The Reaper program was later created to delete Creeper.
1972 (Fiction)

- The science fiction novel, *When HARLIE Was One*, by David Gerrold, contains one of the first fictional representations of a computer virus, as well as one of the first uses of the word "virus" to denote a program that infects a computer.

1973 (Fiction)

- In fiction, the 1973 Michael Crichton movie *Westworld* made an early mention of the concept of a computer virus, being a central plot theme that causes androids to run amok. Alan Oppenheimer's character summarizes the problem by stating that "...there's a clear pattern here which suggests an analogy to an infectious disease process, spreading from one...area to the next." To which the replies are stated: "Perhaps there are superficial similarities to disease" and, "I must confess I find it difficult to believe in a disease of machinery." (Crichton's earlier work, the 1969 novel *The Andromeda Strain* and 1971 film were about an extraterrestrial biological virus-like disease that threatened the human race.)

1974

- The Rabbit (or Wabbit) virus, more a fork bomb than a virus, is written. The Rabbit virus makes multiple copies of itself on a single computer (and was named "Rabbit" for the speed at which it did so) until it clogs the system, reducing system performance, before finally reaching a threshold and crashing the computer.

1975

- April: ANIMAL is written by John Walker for the UNIVAC 1108. ANIMAL asked a number of questions of the user in an attempt to guess the type of animal that the user was thinking of, while the related program PERVADE would create a copy of itself and ANIMAL in every directory to which the current user had access. It spread across the multi-user UNIVACs when users with overlapping permissions discovered the game, and to other computers when tapes were shared. The program was carefully written to avoid damage to existing file or directory structures, and not to copy itself if permissions did not exist or if damage could result. Its spread was therefore halted by an OS upgrade which changed the format of the file status tables that PERVADE used for safe copying. Though non-malicious, "Pervading Animal" represents the first Trojan "in the wild".
- The novel *The Shockwave Rider* by John Brunner is published, coining the word "worm" to describe a program that propagates itself through a computer network.
1981

- A program called Elk Cloner, written for Apple II systems, was created by high school student Richard Skrenta, originally as a prank. The Apple II was particularly vulnerable due to the storage of its operating system computer virus outbreak in history.

1983

- November: The term "virus" is re-coined by Frederick B. Cohen in describing self-replicating computer programs. In 1984 Cohen uses the phrase "computer virus" (suggested by his teacher Leonard Adleman) to describe the operation of such programs in terms of "infection". He defines a "virus" as "a program that can 'infect' other programs by modifying them to include a possibly evolved copy of itself." Cohen demonstrates a virus-like program on a VAX11/750 system at Lehigh University. The program could install itself in, or infect, other system objects. [failed verification]

1984

- August: Ken Thompson publishes his seminal paper, Reflections on Trusting Trust, in which he describes how he modified a C compiler so that when used to compile a specific version of the Unix operating system, it inserts a backdoor into the login command, and when used to compile a new copy of itself, it inserts the backdoor insertion code, even if neither the backdoor nor the backdoor insertion code is present in the source code of this new copy.

1986

- January: The Brain boot sector virus is released. Brain is considered the first IBM PC compatible virus, and the program responsible for the first IBM PC compatible virus epidemic. The virus is also known as Lahore, Pakistani, Pakistani Brain, and Pakistani flu as it was created in Lahore, Pakistan by 19-year-old Pakistani programmer, Basit Farooq Alvi, and his brother, Amjad Farooq Alvi.

- December: Ralf Burger presented the Virdem model of programs at a meeting of the underground Chaos Computer Club in Germany. The Virdem model represented the first programs that could replicate themselves via addition of their code to executable DOS files in COM format.
1987

- Appearance of the Vienna virus, which was subsequently neutralized – the first time this had happened on the IBM platform.

- Appearance of Lehigh virus (discovered at its namesake university), boot sector viruses such as Yale from US, Stoned from New Zealand, Ping Pong from Italy, and appearance of first self-encrypting file virus, Cascade. Lehigh was stopped on campus before it spread to the "wild" (to computers beyond the university), and has never been found elsewhere as a result. A subsequent infection of Cascade in the offices of IBM Belgium led to IBM responding with its own antivirus product development. Prior to this, antivirus solutions developed at IBM were intended for staff use only.

- October: The Jerusalem virus, part of the (at that time unknown) Suriv family, is detected in the city of Jerusalem. The virus destroys all executable files on infected machines upon every occurrence of Friday the 13th (except Friday 13 November 1987 making its first trigger date May 13, 1988). Jerusalem caused a worldwide epidemic in 1988.

- November: The SCA virus, a boot sector virus for Amiga computers, appears. It immediately creates a pandemic virus-writer storm. A short time later, SCA releases another, considerably more destructive virus, the Byte Bandit.

- December: Christmas Tree EXEC was the first widely disruptive replicating network program, which paralyzed several international computer networks in December 1987. It was written in Rexx on the VM/CMS operating system and originated in what was then West Germany. It re-emerged in 1990.

1988

- March 1: The Ping-Pong virus (also called Boot, Bouncing Ball, Bouncing Dot, Italian, Italian-A or VeraCruz), an MS-DOS boot sector virus, is discovered at the University of Turin in Italy.

- June: The CyberAIDS and Festering Hate Apple ProDOS viruses spreads from underground pirate BBS systems and starts infecting mainstream networks. Festering Hate was the last iteration of the CyberAIDS series extending back to 1985 and 1986. Unlike the few Apple viruses that had come before which were essentially annoying, but did no damage, the Festering Hate series of viruses was extremely destructive, spreading to all system files it could find on the host computer (hard drive, floppy, and system memory) and then destroying everything when it could no longer find any uninfected files.

- November 2: The Morris worm, created by Robert Tappan Morris, infects DEC VAX and Sun machines running BSD UNIX that are connected to the Internet, and becomes the first worm to spread extensively "in the wild", and one of the first well-known programs exploiting buffer overrun vulnerabilities.

- December: The Father Christmas worm attacks DEC VAX machines running VAX/VMS that are connected to the DE6net Internet (an international scientific research network using DE6net protocols),
affecting NASA and other research centers. Its purpose was to deliver a Christmas greeting to all affected users.

1989

- October: Ghostball, the first multipartite virus, is discovered by Friðrik Skúlason. It infects both executable .COM-files and boot sectors on MS-DOS systems.
- December: Several thousand floppy disks containing the AIDS Trojan, the first known ransomware, are mailed to subscribers of PC Business World magazine and a WHO AIDS conference mailing list. This DOS Trojan lies dormant for 90 boot cycles, then encrypts all filenames on the system, displaying a notice asking for $189 to be sent to a post office box in Panama in order to receive a decryption program.

1990–1999

1990

- Mark Washburn, working on an analysis of the Vienna and Cascade viruses with Ralf Burger, develops the first family of polymorphic viruses, the Chameleon family. Chameleon series debuted with the release of 1260.
- June: The Form computer virus is isolated in Switzerland. It would remain in the wild for almost 20 years and reappear afterwards; during the 1990s it tended to be the most common virus in the wild with 20 to more than 50 percent of reported infections.

1992

- March: The Michelangelo virus was expected to create a digital apocalypse on March 6, with millions of computers having their information wiped, according to mass media hysteria surrounding the virus. Later assessments of the damage showed the aftermath to be minimal. John McAfee had been quoted by the media as saying that 5 million computers would be affected. He later said that, pressed by the interviewer to come up with a number, he had estimated a range from 5 thousand to 5 million, but the media naturally went with just the higher number.

1993

- "Leandro" or "Leandro & Kelly" and "Freddy Krueger" spread quickly due to popularity of BBS and shareware distribution.
1994

- April: OneHalf is a DOS-based polymorphic computer virus.

1995

- The first Macro virus, called "Concept", is created. It attacked Microsoft Word documents.

1996

- "Ply" – DOS 16-bit based complicated polymorphic virus appeared with built-in permutation engine.
- Boza, the first virus designed specifically for Windows 95 files arrives.
- Laroux, the first Excel macro virus appears.
- Staog, the first Linux virus attacks Linux machines

1998

- June 2: The first version of the CIH virus appears. It is the first known virus able to erase flash ROM BIOS content.

1999

- January 20: The Happy99 worm first appeared. It invisibly attaches itself to emails, displays fireworks to hide the changes being made, and wishes the user a happy New Year. It modifies system files related to Outlook Express and Internet Explorer (IE) on Windows 95 and Windows 98.
- March 26: The Melissa worm was released, targeting Microsoft Word and Outlook-based systems, and creating considerable network traffic.
- June 6: The ExploreZip worm, which destroys Microsoft Office documents, was first detected.
- September: the CTX virus is isolated
- December 30: The Kak worm is a JavaScript computer worm that spread itself by exploiting a bug in Outlook Express.
2000

- May 5: The ILOVEYOU worm (also known as the Love Letter, VBS, or Love Bug worm), a computer worm written in VBScript and using social engineering techniques, infects millions of Windows computers worldwide within a few hours of its release.
- June 28: The Pikachu virus is believed to be the first computer virus geared at children. It contains the character "Pikachu" from the Pokémon series. The operating systems affected by this worm are Windows 95, Windows 98, and Windows ME.

2001

- February 11: The Anna Kournikova virus hits e-mail servers hard by sending e-mail to contacts in the Microsoft Outlook addressbook. Its creator, Jan de Wit, was sentenced to 150 hours of community service.
- May 8: The Sadmind worm spreads by exploiting holes in both Sun Solaris and Microsoft IIS.
- July: The Sircam worm is released, spreading through Microsoft systems via e-mail and unprotected network shares.
- July 13: The Code Red worm attacking the Index Server ISAPI Extension in Microsoft Internet Information Services is released.
- September 18: The Nimda worm is discovered and spreads through a variety of means including vulnerabilities in Microsoft Windows and backdoors left by Code Red II and Sadmind worm.
- October 26: The Klez worm is first identified. It exploits a vulnerability in Microsoft Internet Explorer and Microsoft Outlook and Outlook Express.

2002

- February 11: The Simile virus is a metamorphic computer virus written in assembly.
- Beast is a Windows-based backdoor Trojan horse, more commonly known as a RAT (Remote Administration Tool). It is capable of infecting almost all versions of Windows. Written in Delphi and released first by its author Tataye in 2002, its most current version was released October 3, 2004.
• March 7: MyLife is a computer worm that spread itself by sending malicious emails to all the contacts in Microsoft Outlook.

2003

• January 24: The SQL Slammer worm, aka Sapphire worm, Helkern and other names, attacks vulnerabilities in Microsoft SQL Server and MSDE becomes the fastest spreading worm of all time (measured by doubling time at the peak rate of growth), causing massive Internet access disruptions worldwide just fifteen minutes after infecting its first victim.
• April 2: Graybird is a trojan horse also known as Backdoor.Graybird.
• June 13: ProRat is a Turkish-made Microsoft Windows based backdoor trojan horse, more commonly known as a RAT (Remote Administration Tool).
• August 12: The Blaster worm, aka the Lovesan worm, rapidly spreads by exploiting a vulnerability in system services present on Windows computers.
• August 18: The Welchia (Nachi) worm is discovered. The worm tries to remove the Blaster worm and patch Windows.
• August 19: The Sobig worm (technically the Sobig.F worm) spreads rapidly through Microsoft systems via mail and network shares.
• September 18: Swen is a computer worm written in C++.
• October 24: The Sober worm is first seen on Microsoft systems and maintains its presence until 2005 with many new variants. The simultaneous attacks on network weakpoints by the Blaster and Sobig worms cause massive damage.
• November 10: Agobot is a computer worm that can spread itself by exploiting vulnerabilities on Microsoft Windows. Some of the vulnerabilities are MS03-026 and MS05-039.
• November 20: Bolgimo is a computer worm that spread itself by exploiting a buffer overflow vulnerability at Microsoft Windows DCOM RPC Interface.

2004

• January 18: Bagle is a mass-mailing worm affecting all versions of Microsoft Windows. There were 2 variants of Bagle worm, Bagle.A and Bagle.B. Bagle.B was discovered on February 17, 2004.
• Late January: The MyDoom worm emerges, and currently holds the record for the fastest-spreading mass mailer worm. The worm was most notable for performing a distributed denial-of-service (DDoS) attack on www.sco.com, which belonged to The SCO Group.
• February 16: The Netsky worm is discovered. The worm spreads by email and by copying itself to folders on the local hard drive as well as on mapped network drives if available. Many variants of the Netsky worm appeared.

• March 19: The Witty worm is a record-breaking worm in many regards. It exploited holes in several Internet Security Systems (ISS) products. It was the fastest computer issue to be categorized as a worm, and it was the first internet worm to carry a destructive payload. It spread rapidly using a pre-populated list of ground-zero hosts.

• May 1: The Sasser worm emerges by exploiting a vulnerability in the Microsoft Windows LSASS service and causes problems in networks, while removing MyDoom and Bagle variants, even interrupting business.

• June 15: Caribe or Cabir is a computer worm that is designed to infect mobile phones that run Symbian OS. It is the first computer worm that can infect mobile phones. It spread itself through Bluetooth. More information can be found on F-Secure and Symantec.

• August 16: Nuclear RAT (short for Nuclear Remote Administration Tool) is a backdoor trojan that infects Windows NT family systems (Windows 2000, Windows XP, Windows 2003).

• August 20: Vundo, or the Vundo Trojan (also known as Virtumonde or Virtumondo and sometimes referred to as MS Juan) is a trojan known to cause popups and advertising for rogue antispyware programs, and sporadically other misbehaviour including performance degradation and denial of service with some websites including Google and Facebook.

• October 12: Bifrost, also known as Bifrose, is a backdoor trojan which can infect Windows 95 through Vista. Bifrost uses the typical server, server builder, and client backdoor program configuration to allow a remote attack.

• December: Santy, the first known "webworm" is launched. It exploited a vulnerability in phpBB and used Google in order to find new targets. It infected around 40000 sites before Google filtered the search query used by the worm, preventing it from spreading.

2005

• August 2005: Zotob
• October 2005: The copy protection rootkit deliberately and surreptitiously included on music CDs sold by Sony BMG is exposed. The rootkit creates vulnerabilities on affected computers, making them susceptible to infection by worms and viruses.
• Late 2005: The Zlob Trojan, is a Trojan horse program that masquerades as a required video codec in the form of the Microsoft Windows ActiveX component. It was first detected in late 2005.
2006

- January 20: The Nyxem worm was discovered. It spread by mass-mailing. Its payload, which activates on the third of every month, starting on February 3, attempts to disable security-related and file sharing software, and destroy files of certain types, such as Microsoft Office files.
- February 16: discovery of the first-ever malware for Mac OS X, a low-threat trojan-horse known as OSX/Leap-A or OSX/Oompa-A, is announced.
- Late March: Brontok variant N was found in late March. Brontok was a mass-email worm and the origin for the worm was from Indonesia.
- June: Starbucks is a virus that infects StarOffice and OpenOffice.
- Late September: Stration or Warezov worm first discovered.
- Stuxnet

2007

- January 17: Storm Worm identified as a fast spreading email spamming threat to Microsoft systems. It begins gathering infected computers into the Storm botnet. By around June 30 it had infected 1.7 million computers, and it had compromised between 1 and 10 million computers by September. Thought to have originated from Russia, it disguises itself as a news email containing a film about bogus news stories asking you to download the attachment which it claims is a film.
- July: Zeus is a trojan that targets Microsoft Windows to steal banking information by keystroke logging.

2008

- February 17: Mocmex is a trojan, which was found in a digital photo frame in February 2008. It was the first serious computer virus on a digital photo frame. The virus was traced back to a group in China.
- March 3: Torpig, also known as Sinowal and Mebroot, is a Trojan horse that affects Windows, turning off anti-virus applications. It allows others to access the computer, modifies data, steals confidential information (such as user passwords and other sensitive data) and installs more malware on the victim's computer.
- May 6: Rustock.C, a hitherto-rumoured spambot-type malware with advanced rootkit capabilities, was announced to have been detected on Microsoft systems and analyzed, having been in the wild and undetected since October 2007 at the very least.
- July 6: Bohmini.A is a configurable remote access tool or trojan that exploits security flaws in Adobe Flash 9.0.115 with Internet Explorer 7.0 and Firefox 2.0 under Windows XP SP2.
- July 31: The Koobface computer worm targets users of Facebook and Myspace. New variants constantly appear.
- November 21: Computer worm Conficker infects anywhere from 9 to 15 million Microsoft server systems running everything from Windows 2000 to the Windows 7 Beta. The French Navy, UK Ministry of Defence (including Royal Navy warships and submarines), Sheffield Hospital network, German Bundeswehr and Norwegian Police were all affected. Microsoft sets a bounty of US$250,000 for information leading to the capture of the worm's author(s). Five main variants of the Conficker worm are known and have been dubbed Conficker A, B, C, D and E. They were discovered 21 November 2008, 29 December 2008, 20 February 2009, 4 March 2009 and 7 April 2009, respectively. On December 16, 2008, Microsoft releases KB958644 patching the server service vulnerability responsible for the spread of Conficker.

2009

- July 4: The July 2009 cyber attacks occur and the emergence of the W32.Dozer attack the United States and South Korea.
- July 15: Symantec discovered Daprosy Worm. Said trojan worm is intended to steal online-game passwords in internet cafes. It could, in fact, intercept all keystrokes and send them to its author which makes it potentially a very dangerous worm to infect B2B (business-to-business) systems.
- August 24: Source code for MegaPanzer is released by its author under GPLv3. and appears to have been apparently detected in the wild.
- November 27: The virus called Kenzero is a virus that spreads online from peer-to-peer networks (P2P) taking browsing history.

2010–present

2010

- January: The Waledac botnet sent spam emails. In February 2010, an international group of security researchers and Microsoft took Waledac down.
- January: The Psyb0t worm is discovered. It is thought to be unique in that it can infect routers and high-speed modems.
- February 18: Microsoft announced that a BSoD problem on some Windows machines which was triggered by a batch of Patch Tuesday updates was caused by the Alureon Trojan.
• June 17: Stuxnet, a Windows Trojan, was detected. It is the first worm to attack SCADA systems. There are suggestions that it was designed to target Iranian nuclear facilities. It uses a valid certificate from Realtek.

• September 9: The virus, called "here you have" or "VBMania", is a simple Trojan horse that arrives in the inbox with the odd-but-suggestive subject line "here you have". The body reads "This is The Document I told you about, you can find it Here" or "This is The Free Download Sex Movies, you can find it Here".

2011

• SpyEye and Zeus merged code is seen. New variants attack mobile phone banking information.

• Anti-Spyware 2011, a Trojan horse that attacks Windows 9x, 2000, XP, Vista, and Windows 7, posing as an anti-spyware program. It disables security-related processes of anti-virus programs, while also blocking access to the Internet, which prevents updates.

• Summer 2011: The Morto worm attempts to propagate itself to additional computers via the Microsoft Windows Remote Desktop Protocol (RDP). Morto spreads by forcing infected systems to scan for Windows servers allowing RDP login. Once Morto finds an RDP-accessible system, it attempts to log into a domain or local system account named 'Administrator' using a number of common passwords. A detailed overview of how the worm works – along with the password dictionary Morto uses – was done by Imperva.

• July 13: the ZeroAccess rootkit (also known as Sirefef or max++) was discovered.

• September 1: Duqu is a worm thought to be related to the Stuxnet worm. The Laboratory of Cryptography and System Security (CrySyS Lab) of the Budapest University of Technology and Economics in Hungary discovered the threat, analysed the malware, and wrote a 60-page report naming the threat Duqu. Duqu gets its name from the prefix "~DQ" it gives to the names of files it creates.

2012

• May: Flame – also known as Flamer, sKyWIper, and Skywiper – a modular computer malware that attacks computers running Microsoft Windows. Used for targeted cyber espionage in Middle Eastern countries. Its discovery was announced on 28 May 2012 by MAHER Center of Iranian National Computer Emergency Response Team (CERT), Kaspersky Lab and CrySyS Lab of the Budapest University of Technology and Economics. CrySyS stated in their report that "sKyWIper is certainly the most sophisticated malware we encountered during our practice; arguably, it is the most complex malware ever found".

• August 16: Shamoon is a computer virus designed to target computers running Microsoft Windows in the energy sector. Symantec, Kaspersky Lab, and Seculert announced its discovery on August 16, 2012.

• September 20: NGRBot is a worm that uses the IRC network for file transfer, sending and receiving commands between zombie network machines and the attacker's IRC server, and monitoring and
controlling network connectivity and intercept. It employs a user-mode rootkit technique to hide and steal its victim's information. This family of bot is also designed to infect HTML pages with inline frames (iframes), causing redirections, blocking victims from getting updates from security/antimalware products, and killing those services. The bot is designed to connect via a predefined IRC channel and communicate with a remote botnet.

2013

- September: The CryptoLocker Trojan horse is discovered. CryptoLocker encrypts the files on a user's hard drive, then prompts them to pay a ransom to the developer in order to receive the decryption key. In the following months, a number of copycat ransomware Trojans were also discovered.
- December: The Gameover ZeuS Trojan is discovered. This type of virus steals one's login details on popular Web sites that involve monetary transactions. It works by detecting a login page, then proceeds to inject a malicious code into the page, keystroke logging the computer user's details.
- December: Linux.Darlloz targets the Internet of things and infects routers, security cameras, set-top boxes by exploiting a PHP vulnerability.

2014

- November: The Regin Trojan horse is discovered. Regin is a dropper that is primarily spread via spoofed Web pages. Once downloaded, Regin quietly downloads extensions of itself, making it difficult to be detected via anti-virus signatures. It is suspected to have been created by the United States and United Kingdom over a period of months or years, as a tool for espionage and mass surveillance.

2015

- The BASHLITE malware is leaked leading to a massive spike in DDoS attacks.
- Linux.Wifatch is revealed to the general public. It is found to attempt to secure devices from other more malicious malware.

2016

- January: A trojan named "MEMZ" is created. The creator, Leurak, explained that the trojan was intended merely as a joke. The trojan alerts the user to the fact that it is a trojan and warns them that if they proceed, the computer may no longer be usable. It contains complex payloads that corrupt the system, displaying artifacts on the screen as it runs. Once run, the application cannot be closed without causing further damage to the computer, which will stop functioning properly regardless. When the computer is
restarted, in place of the bootsplash is a message that reads "Your computer has been trashed by the MEMZ Trojan. Now enjoy the Nyan cat...", which follows with an animation of the Nyan Cat.

- February: Ransomware Locky with its over 60 derivatives spread throughout Europe and infected several million computers. At the height of the spread over five thousand computers per hour were infected in Germany alone. Although ransomware was not a new thing at the time, insufficient cyber security as well as a lack of standards in IT was responsible for the high number of infections. Unfortunately, even up to date antivirus and internet security software was unable to protect systems from early versions of Locky.

- February: Tiny Banker Trojan (Tinba) makes headlines. Since its discovery, it has been found to have infected more than two dozen major banking institutions in the United States, including TD Bank, Chase, HSBC, Wells Fargo, PNC and Bank of America. Tiny Banker Trojan uses HTTP injection to force the user's computer to believe that it is on the bank's website. This spoof page will look and function just as the real one. The user then enters their information to log on, at which point Tinba can launch the bank webpage's "incorrect login information" return, and redirect the user to the real website. This is to trick the user into thinking they had entered the wrong information and proceed as normal, although now Tinba has captured the credentials and sent them to its host.

- September: Mirai creates headlines by launching some of the most powerful and disruptive DDoS attacks seen to date by infecting the Internet of Things. Mirai ends up being used in the DDoS attack on 20 September 2016 on the Krebs on Security site which reached 620 Gbit/s. Ars Technica also reported a 1 Tbit/s attack on French web host OVH. On 21 October 2016 multiple major DDoS attacks in DNS services of DNS service provider Dyn occurred using Mirai malware installed on a large number of IoT devices, resulting in the inaccessibility of several high-profile websites such as GitHub, Twitter, Reddit, Netflix, Airbnb and many others. The attribution of the attack to the Mirai botnet was originally reported by BackConnect Inc., a security firm.

2017

- May: The WannaCry ransomware attack spreads globally. Exploits revealed in the NSA hacking toolkit leak of late 2016 were used to enable the propagation of the malware. Shortly after the news of the infections broke online, a UK cybersecurity researcher in collaboration with others found and activated a "kill switch" hidden within the ransomware, effectively halting the initial wave of its global propagation. The next day, researchers announced that they had found new variants of the malware without the kill switch.

- June: The Petya (malware) attack spreads globally affecting Windows systems. Researchers at Symantec reveal that this ransomware uses the EternalBlue exploit, similar to the one used in the WannaCry ransomware attack.
- September: The Xafecopy Trojan attacks 47 countries, affecting only Android operating systems. Kaspersky Lab identified it as a malware from the Ubsod family, stealing money through click based WAP billing systems.

- September: A new variety of Remote Access Trojan (RAT), Kedi RAT, is distributed in a Spear Phishing Campaign. The attack targeted Citrix users. The Trojan was able to evade usual system scanners. Kedi Trojan had all the characteristics of a common Remote Access Trojan and it could communicate to its Command and Control center via Gmail using common HTML, HTTP protocols.

2018

- February: Thanatos, a ransomware, becomes the first ransomware program to accept ransom payment in Bitcoin Cash.

2019

- November: Titanium is an advanced and insidious backdoor malware APT, developed by PLATINUM.

Timeline of HIV/AIDS

Pre-1980s

1900s

- Researchers estimate that some time in the early 1900s a form of simian immunodeficiency virus, SIV, was transmitted to humans in Central Africa. This particular virus, group M of HIV-1, went on to become the pandemic strain of HIV, though others have been identified.

1920s

- Scientists estimate that HIV was circulating in Léopoldville (modern-day Kinshasa) by the 1920s.

1959

- The first known case of HIV in a human occurs in a man who died in the Congo, later (from his preserved blood samples) confirmed as having HIV infection.
June 28, in New York City, Ardouin Antonio, a 49-year-old Haitian shipping clerk dies of Pneumocystis carinii pneumonia, a disease closely associated with AIDS. Gordon Hennigar, who performed the postmortem examination of the man's body, found "the first reported instance of unassociated Pneumocystis carinii disease in an adult" to be so unusual that he preserved Ardouin's lungs for later study. The case was published in two medical journals at the time, and Hennigar has been quoted in numerous publications saying that he believes Ardouin probably had AIDS.

1960s

- HIV-2, a viral variant found in West Africa, is thought to have transferred to people from sooty mangabey monkeys in Guinea-Bissau.

1964

- Jerome Horwitz of Barbara Ann Karmanos Cancer Institute and Wayne State University School of Medicine synthesize AZT under a grant from the US National Institutes of Health (NIH). AZT was originally intended as an anticancer drug.

1966

- Genetic studies of the virus indicate that, in or about 1966, HIV first arrived in the Americas, infecting one person in Haiti. At this time, many Haitians were working in Congo, providing the opportunity for infection.

1968

- A 2003 analysis of HIV types found in the United States, compared to known mutation rates, suggests that the virus may have first arrived in the United States in this year. The disease spread from the 1966 American strain, but remained unrecognized for another 12 years. This is, however, contradicted by the estimated area of time of initial infection of Robert Rayford who was most likely infected around 1959.

1969

- A St. Louis teenager, identified as Robert Rayford, dies of an illness that baffles his doctors. Eighteen years later, molecular biologists at Tulane University in New Orleans test samples of his remains and find evidence of HIV.

1976
• The 9-year-old daughter of Arvid Noe dies in January. Noe, a Norwegian sailor, dies in April; his wife dies in December. Later it is determined that Noe contracted HIV/AIDS in Africa during the early 1960s.

1977

• Danish physician Grethe Rask dies of AIDS contracted in Africa.
• A San Francisco woman, believed to be a sex-worker, gives birth to the first of three children who were later diagnosed with AIDS. The children's blood was tested after their deaths and revealed an HIV infection. The mother died of AIDS in May 1987. Test results show she was infected no later than 1977.
• French-Canadian flight attendant Gaëtan Dugas, a relatively early HIV patient, gets legally married in Los Angeles in order to get citizenship. He stays in Silver Lake, a section of Los Angeles, whenever he is in town.

1978

• A Portuguese man known as Senhor José (English: Mr. Joseph) dies; he will later be confirmed as the first known infection of HIV-2. It is believed that he was exposed to the disease in Guinea-Bissau in 1966.

1979

• An early case of AIDS in the United States was of a female baby born in New Jersey in 1973 or 1974. She was born to a sixteen-year-old girl, an identified drug-injector, who had previously had multiple male sexual partners. The baby died in 1979 at the age of five. Subsequent testing on her stored tissues confirmed that she had contracted HIV-1.
• A thirty-year-old woman from the Dominican Republic dies at Mount Sinai Medical Center in New York City from CMV infection.

1980s

1980

• April 24, San Francisco resident Ken Horne is reported to the Center for Disease Control with Kaposi's sarcoma (KS). Later in 1981, the CDC would retroactively identify him as the first patient of the AIDS epidemic in the US. He was also suffering from Cryptococcus.
• A 36-year-old Danish homosexual male passes away in the Rigshospitalet in Copenhagen from Pneumocystis pneumonia.
• October 31, Gaëtan Dugas pays his first known visit to New York City bathhouses.
December 23, Rick Wellikoff, a Brooklyn schoolteacher, dies of AIDS in New York City. He is the 4th US citizen known to die from the illness.

A Zairian woman and a French woman die in late 1980 of Pneumocystis Pneumonia in the Claude Bernard Hospital in Paris.

1981

May 18, Lawrence Mass becomes the first journalist in the world to write about the epidemic, in the New York Native, a gay newspaper. A gay tipster overheard his physician mention that some gay men were being treated in intensive-care units in New York City for a strange pneumonia. "Disease Rumors Largely Unfounded" was the headline of Mass's article. Mass repeated a New York City public-health official's claims that there was no wave of disease sweeping through the gay community. At this point, however, the Centers for Disease Control (CDC) had been gathering information for about a month on the outbreak that Mass's source dismissed.

June 5, The CDC reports a cluster of Pneumocystis pneumonia in five gay men in Los Angeles.

July 3, An article in The New York Times carries the headline: "Rare Cancer Seen in 41 Homosexuals". The article describes cases of Kaposi's sarcoma found in forty-one gay men in New York City and San Francisco. The CDC reports clusters of Kaposi's sarcoma and Pneumocystis pneumonia among gay men in California and New York City.

December, self-proclaimed "AIDS poster boy" Bobbi Campbell is San Francisco diagnosed with Kaposi's sarcoma.

October, first reported case in Spain, a 35-year-old gay man. Died shortly after.

December 12, First known case reported in the United Kingdom.

One of the first reported patients to have died of AIDS (presumptive diagnosis) in the US is reported in the journal Gastroenterology. Louis Weinstein, the treating physician, wrote that "Immunologic incompetence, related to either disease or therapy, or both ... although suspected, could not be proved..."

By the end of the year December 31st, 337 people are known to have had the disease, 321 adults, and 16 children under the age of 13 and of those 130 had died from the disease.

1982

January, the service organization Gay Men's Health Crisis is founded by Larry Kramer and others in New York City.

June 18, "Exposure to some substance (rather than an infectious agent) may eventually lead to immunodeficiency among a subset of the homosexual male population that shares a particular style of
life." For example, Marmor et al. recently reported that exposure to amyl nitrite was associated with an increased risk of KS in New York City. Exposure to inhalant sexual stimulants, central-nervous-system stimulants, and a variety of other "street" drugs was common among males belonging to the cluster of cases of KS and PCP in Los Angeles and Orange counties.

- July 4, Terry Higgins becomes one of the first people to die of AIDS-related illnesses in the United Kingdom, prompting the foundation in November of what was to become the Terrence Higgins Trust.
- July 9, The CDC reports a cluster of opportunistic infections (OI) and Kaposi's sarcoma among Haitians recently entering the United States.
- July 27, The term AIDS (acquired immune deficiency syndrome) is proposed at a meeting in Washington, D.C. of gay-community leaders, federal bureaucrats and the CDC to replace GRID (gay-related immune deficiency) as evidence showed it was not gay specific.
- Summer, First known case in Italy.
- September 24, The CDC defines a case of AIDS as a disease, at least moderately predictive of a defect in cell-mediated immunity, occurring in a person with no known cause for diminished resistance to that disease. Such diseases include KS, PCP, and serious OI. Diagnoses are considered to fit the case definition only if based on sufficiently reliable methods (generally histology or culture). Some patients who are considered AIDS cases on the basis of diseases only moderately predictive of cellular immunodeficiency may not actually be immunodeficient and may not be part of the current epidemic.
- December 10, a baby in California becomes ill in the first known case of contracting AIDS from a blood transfusion.
- First known case in Brazil.
- First known case in Canada.
- First known case in Australia, diagnosed at St Vincent's Hospital, Sydney.

1983

- January, Françoise Barré-Sinoussi, at the Pasteur Institute in Paris, isolates a retrovirus that kills T-cells from the lymph system of a gay AIDS patient. In the following months, she would find it in additional gay and hemophiliac sufferers. This retrovirus would be called by several names, including LAV and HTLV-III before being named HIV in 1986.
- CDC National AIDS Hotline is established.
- March, United States Public Health Service (PHS or USPHS) issues donor screening guidelines. AIDS high-risk groups should not donate blood/plasma products.
- In March, AIDS Project Los Angeles is founded by Nancy Cole Sawaya, Matt Redman, Ervin Munro, and Max Drew
• First known case in Colombia, a female sexual worker from Cali was diagnosed with HIV in the Hospital Universitario de Cartagena.

• First AIDS-related death occurs in Australia, in the city of Melbourne. The Hawke Labor government invests in a significant campaign that has been credited with ensuring Australia has one of the lowest HIV infection rates in the world.

• AIDS is diagnosed in Mexico for the first time. HIV can be traced in the country to 1981.

• The PCR (polymerase chain reaction) technique is developed by Kary Mullis; it is widely used in AIDS research.

• Within a few days of each other, the musicians Jobriath and Klaus Nomi become the first internationally known recording artists to die from AIDS-related illnesses.

• First known case in Portugal.

1984

• Around January, the first case of HIV infection in the Philippines was reported.

• Gaëtan Dugas passes away due to AIDS-related illnesses. He was a French-Canadian flight attendant who was falsely identified as patient 0 due to his central location and labeling as "patient O," as in the letter O, in a scientific study of 40 infected Americans from multiple U.S. cities.

• Roy Cohn is diagnosed with AIDS, but attempts to keep his condition secret while receiving experimental drug treatment.

• April 23, U.S. Health and Human Services Secretary Margaret Heckler announces at a press conference that an American scientist, Robert Gallo, has discovered the probable cause of AIDS: the retrovirus is subsequently named human immunodeficiency virus or HIV in 1986. She also declares that a vaccine will be available within two years.

• June 25, French philosopher Michel Foucault dies of AIDS in Paris.

• September 6, First performance at Theatre Rhinoceros in San Francisco of The AIDS Show which runs for two years and is the subject of a 1986 documentary film of the same name.

• December 17, Ryan White was diagnosed with AIDS by a doctor performing a partial lung removal. White became infected with HIV from a blood product that was administered to him on a regular basis as part of his treatment for hemophilia. When the public school that he attended, Western Middle School in Russiaville, Indiana, learned of his disease in 1985 there was enormous pressure from parents and faculty to bar him from school premises. Due to the widespread fear of AIDS and lack of medical knowledge, principal Ron Colby and the school board assented. His family filed a lawsuit, seeking to overturn the ban.

1985
• March 2, the FDA approves an ELISA test as the first commercially available test for detecting HIV in blood. It detects antibodies which the body makes in response to exposure to HIV and is first intended for use on all donated blood and plasma intended for transfusion and product manufacture.

• April 21, the play The Normal Heart by Larry Kramer premieres in New York City.

• July 28, AIDS Project Los Angeles hosts the world's first AIDS Walk at Paramount Studios in Hollywood. More than 4,500 people helped the Walk surpass its $100,000 goal, raising $673,000.

• September 17, during his second term in office, President Ronald Reagan publicly mentions AIDS for the first time when asked about the lack of medical research funding by an AP reporter during a press conference.

• September 19, The first Commitment to Life is held in Los Angeles. Elizabeth Taylor hosted the event and honored former First Lady Betty Ford. Taylor said at the event "Tonight is the start of my personal war on this disease, AIDS." The event raised more than $1 million for AIDS Project Los Angeles.

• October 2, Rock Hudson dies of AIDS. On July 25, 1985, he was the first American celebrity to publicly admit having AIDS; he had been diagnosed with it on June 5, 1984.

• October 12, Ricky Wilson, guitarist of American rock band The B-52's dies from an AIDS related illness. The album Bouncing Off The Satellites, which he was working on when he died, is dedicated to him when it is released the next year. The band is devastated by the loss and do not tour or promote the album. Wilson is eventually replaced on guitar by his former writing partner Keith Strickland, the B52's former drummer.

• October, a conference of public health officials including representatives of the Centers for Disease Control and World Health Organization meet in Bangui and define AIDS in Africa as "prolonged fevers for a month or more, weight loss of over 10% and prolonged diarrhea".

• First officially reported cases in China.

• November 11, An Early Frost, the first film to cover the topic of HIV/AIDS is broadcast in the U.S. on prime time TV by NBC.

1986

• HIV (human immunodeficiency virus) is adopted as name of the retrovirus that was first proposed as the cause of AIDS by Luc Montagnier of France, who named it LAV (lymphadenopathy associated virus) and Robert Gallo of the United States, who named it HTLV-III (human T-lymphotropic virus type III)

• January 14, "one million Americans have already been infected with the virus and that this number will jump to at least 2 million or 3 million within 5 to 10 years..." – NIAID Director Anthony Fauci, New York Times.
- February, President Reagan instructs his Surgeon General C. Everett Koop to prepare a report on AIDS. (Koop was excluded from the Executive Task Force on AIDS established in 1983 by his immediate superior, Assistant Secretary of Health Edward Brandt.) Without allowing Reagan's domestic policy advisers to review the report, Koop released the report at a press conference on October 22, 1986.

- May 30, fashion designer Perry Ellis dies of AIDS-related illness.

- Attorney Geoffrey Bowers is fired from the firm of Baker & McKenzie after AIDS-related Kaposi's sarcoma lesions appeared on his face. The firm maintained that he was fired purely for his performance. He sued the firm, in one of the first AIDS discrimination cases to go to a public hearing. These events were the inspiration for the 1993 film Philadelphia.

- August 2, Roy Cohn dies of complications from AIDS at the age of 59. He insists to the end that his disease was liver cancer.

- November 18, model Gia Carangi dies of AIDS-related illness.

- First officially known cases in the Soviet Union and India.

1987

- AZT (zidovudine), the first antiretroviral drug, becomes available to treat HIV.

- On February 4, popular performing musician Liberace dies from AIDS related illness.

- In April the FDA approves a Western blot test as a more precise test for the presence of HIV antibodies than the ELISA test.

- In March, the direct action advocacy group ACT UP is founded by Larry Kramer in New York City.

- On May 28, playwright and performer Charles Ludlam dies of AIDS-related PCP pneumonia.

- On July 11, Tom Waddell, founder of the Gay Games, dies of AIDS.

- Randy Shilts's investigative journalism book And the Band Played On published chronicling the 1980–1985 discovery and spread of HIV/AIDS, government indifference, and political infighting in the United States to what was initially perceived as a gay disease. (Shilts died of the disease on February 17, 1994.)

- On August 18 the FDA sanctioned the first clinical trial to test an HIV vaccine candidate in a research participant.

1988

- May, C. Everett Koop sends an eight-page, condensed version of his Surgeon General's Report on Acquired Immune Deficiency Syndrome report named Understanding AIDS to all 107,000,000 households in the United States, becoming the first federal authority to provide explicit advice to US citizens on how to protect themselves from AIDS.
- March 3, John Holmes dies from AIDS-related complications.
- November 11, The fact-based AIDS-themed film Go Toward the Light is broadcast on CBS.
- December 1, The first World AIDS Day takes place.
- In Buenos Aires, Argentina, the rock musicians Miguel Abuelo (March 26) and Federico Moura (December 21), die from AIDS-related complications.
- American disco singer Sylvester dies of AIDS in San Francisco.

1989

- The television movie The Ryan White Story airs. It stars Judith Light as Jeanne, Lukas Haas as Ryan and Nikki Cox as sister Andrea. Ryan White had a small cameo appearance as Chad, a young patient with AIDS. Another AIDS-themed film, The Littlest Victims, debuted in 1989, biopicing James Oleske, the first U.S. physician to discover AIDS in newborns during AIDS' early years, when many thought it was only spread through male-to-male sexual activity.
- "Covering the Plague" by James Kinsella is published, providing a scathing look into how the media fumbled the AIDS story.
- British travel writer Bruce Chatwin dies from AIDS-related complications.
- NASCAR driver Tim Richmond dies from AIDS-related complications.
- Amanda Blake best known for her portrayal of saloon owner Miss Kitty on the television show Gunsmoke becomes the first actress of note in the United States to die of AIDS-related illness. The cause of death was cardiac arrest stemming from CMV hepatitis, an AIDS-related hepatitis.

1990s

1990

- January 6, British actor Ian Charleson dies from AIDS at the age of 40 — the first show-business death in the United Kingdom openly attributed to complications from AIDS.
- February 16, New York artist and social activist Keith Haring dies from AIDS-related illness.
- April 8, Ryan White dies at the age of 18 from pneumonia caused by complications associated with AIDS.
- Congress enacted The Ryan White Comprehensive AIDS Resources Emergency (CARE) Act or Ryan White Care Act, the United States' largest federally funded health related program (excluding Medicaid and Medicare).
- July 7, Brazilian singer Cazuza dies in Rio de Janeiro at the age of 32 from an AIDS-related illness.
November 9, American singer-songwriter Tom Fogerty, rhythm guitarist of Creedence Clearwater Revival and older brother of John Fogerty, dies in Berkeley, California of AIDS-related tuberculosis.

1991

May, the play Angels in America: A Gay Fantasia on National Themes by Tony Kushner premieres in San Francisco.

September 28, jazz legend Miles Davis dies at the age of 65. The official cause of death is bronchial pneumonia. He was taking Zidovudine (AZT) when hospitalized; at the time, Zidovudine (AZT) was a treatment for HIV and AIDS.

November 7, NBA star Magic Johnson publicly announces that he is HIV-positive.

November 24, A little over 24 hours after issuing a statement confirming that he had been tested HIV positive and had AIDS, Freddie Mercury (singer of the British band Queen) dies at the age of 45. The official cause of death is bronchial pneumonia resulting from AIDS.

1992

The first combination drug therapies for HIV are introduced.

April 6, popular science fiction writer Isaac Asimov dies. Ten years later, his wife revealed that his death was due to AIDS-related complications. The writer was infected during a blood transfusion in 1983.

June 18, Australian singer Peter Allen dies from complications due to AIDS.

September 12, American actor Anthony Perkins, known for his role as Norman Bates in the Psycho movies, dies from AIDS.

At the Royal Free Hospital in London, an out-patients' centre for HIV and AIDS is opened by Ian McKellen. It is named the Ian Charleson Day Centre after actor Ian Charleson.

Robert Reed, best known as Mike Brady on the sitcom The Brady Bunch dies of AIDS on May 12.


1993

Rudolf Nureyev, one of the world's greatest ballet dancers, dies from AIDS on January 6.

Tennis star Arthur Ashe dies from AIDS-related complications

1994
• Randy Shilts author of And the Band Played On: Politics, People, and the AIDS Epidemic, dies at his home of AIDS related complications.

• Elizabeth Glaser, wife of Starsky & Hutch's Paul Michael Glaser, dies from AIDS-related complications almost 10 years after receiving an infected blood transfusion while giving birth. She unknowingly passes HIV on to her daughter Ariel and son Jake. Ariel died in 1988, Jake is living with HIV, while Paul Michael remains negative.

• Sarah Jane Salazar, a 19-year-old Filipino AIDS activist and educator, publicly admits she contracted HIV from a foreign customer while working as a club entertainer in the early 1990s. She was the second Filipino to do so. The first was Dolzura Cortez.

1995

• Saquinavir, a new type of protease inhibitor drug, becomes available to treat HIV. Highly active antiretroviral therapy (HAART) becomes possible. Within two years, death rates due to AIDS will have plummeted in the developed world.

• March 26, Rapper Eazy-E dies from AIDS-related pneumonia.

• April 4, British DJ and entertainer Kenny Everett dies from AIDS.

• Oakland, California resident Jeff Getty becomes the first person to receive a bone marrow transplant from a Baboon as an experimental procedure to treat his HIV infection. The graft did not take, but Getty experienced some reduction in symptoms before dying of heart failure after cancer treatment in 2006.

1996

• Robert Gallo's discovery that some natural compounds known as chemokines can block HIV and halt the progression of AIDS is hailed by Science as one of that year's most important scientific breakthroughs.

• HIV resistance due to the CCR5-Δ32 discovered. CCR5-Δ32 (or CCR5-D32 or CCR5 delta 32) is an allele of CCR5.

• Brazilian Law No. 9313, enacted on November 13, 1996, provided every Brazilian with HIV virus the right to free medication.

1997

• September 2, The Washington Post carries an article stating, "The most recent estimate of the number of Americans infected (with HIV), 750,000, is only half the total that government officials used to cite over a decade ago, at a time when experts believed that as many as 1.5 million people carried the virus."
Based on the Bangui definition the WHO's cumulative number of reported AIDS cases from 1980 through 1997 for all of Africa is 620,000. For comparison, the cumulative total of AIDS cases in the USA through 1997 is 641,087.

December 7, "French President Jacques Chirac addressed Africa's top AIDS conference on Sunday and called on the world's richest nations to create an AIDS therapy support fund to help Africa. According to Chirac, Africa struggles to care for two-thirds of the world's persons with AIDS without the benefit of expensive AIDS therapies. Chirac invited other countries, especially European nations, to create a fund that would help increase the number of AIDS studies and experiments. AIDS workers welcomed Chirac's speech and said they hoped France would promote the idea to the Group of Eight summit of the world's richest nations."

1998

December 10, International Human Rights Day, Treatment Action Campaign (TAC) is launched to campaign for greater access to HIV treatment for all South Africans, by raising public awareness and understanding about issues surrounding the availability, affordability and use of HIV treatments. TAC campaigns against the view that AIDS is a death sentence.

1999

January 31, Studies suggest that a retrovirus, SIVcpz (simian immunodeficiency virus) from the common chimpanzee Pan troglodytes, may have passed to human populations in west equatorial Africa during the twentieth century and developed into various types of HIV.

Edward Hooper releases a book titled The River, which accuses doctors who developed and administered the oral polio vaccine in 1950s Africa of unintentionally starting the AIDS epidemic. The OPV AIDS hypothesis receives a great deal of publicity. It was later refuted by studies demonstrating the origins of HIV as a mutated variant of a simian immunodeficiency virus that is lethal to humans. Hooper's hypothesis should not be confused with the Heart of Darkness origin theory.

2000s

2000

World Health Organization estimates between 15% and 20% of new HIV infections worldwide are the result of blood transfusions, where the donors were not screened or inadequately screened for HIV.

February 23, Israeli singer Ofra Haza died in Tel Aviv of AIDS-related pneumonia.
• June 11, Sarah Jane Salazar died at the age of 25 from AIDS complications. Before her death, Salazar was confined at the National Center for Mental Health after being diagnosed with manic depression which doctors said may have been related to anti-AIDS drugs she was taking.

2001

• September 21, FDA licenses the first nucleic acid test (NAT) systems intended for screening of blood and plasma donations.

2002

• The Food and Drug Administration (FDA) approves the first rapid diagnostic HIV test kit for use in the United States. The kit has a 99.6% accuracy and can provide results in as little as twenty minutes. The test kit can be used at room temperature, did not require specialized equipment, and can be used outside of clinics and doctor's offices. The mobility and speed of the test allowed a wider spread use of HIV testing.

2003

• President George W Bush initiates the President's Emergency Plan for AIDS Relief. By the time he leaves office it provides medicine for 2 million Africans.

2004

• January 5, "Individual risk of acquiring HIV and experiencing rapid disease progression is not uniform within populations", says Anthony S. Fauci, the director of NIAID.

2005

• January 21, The CDC recommends anti-retroviral post-exposure prophylaxis for people exposed to HIV from rapes, accidents or occasional unsafe sex or drug use. This treatment should start no more than 72 hours after a person has been exposed to the virus, and the drugs should be used by patients for 28 days. This emergency drug treatment has been recommended since 1996 for health-care workers accidentally stuck with a needle, splashed in their eyes with blood, or exposed in some other work-related way.

• A highly resistant strain of HIV linked to rapid progression to AIDS is identified in New York City.

2006

• November 9, SIV found in gorillas.
2007

- The first case of someone being cured of HIV is reported. A San Francisco man, Timothy Ray Brown, suffering from leukemia and HIV, is cured of HIV through a bone marrow transplant in Germany from a homozygous CCR5−Δ32 donor. Other similar cases are being studied to confirm similar results.
- Maraviroc, the first available CCR5 receptor antagonist, is approved by the FDA as an antiviral drug for the treatment of AIDS.

2010s

2010

- Confirmation is published that the first patient cured of HIV, Timothy Ray Brown, still has a negative HIV status, 4 years after treatment.

2012

- The Food and Drug Administration (FDA) approves Truvada for pre-exposure prophylaxis (PrEP). The drug can be taken by adults who do not have HIV, but are at risk for the disease. People can now take this medication to reduce their risk for contracting the virus through sexual activity.

2013

- Confirmation is published that a toddler has been "functionally cured" of HIV infection. However, in 2014, it was announced that the child had relapsed and that the virus had re-appeared.
- A New York Times Article says that 12 people of 75 who began combination antiretroviral therapy soon after becoming infected may have been "functionally cured" of HIV according to a French study. A functionally cured person will not experience an increase of the virus in the bloodstream despite stopping antiretroviral therapy, and therefore not progress to AIDS.

2014

- Former International AIDS Society president Joep Lange and other HIV/AIDS researchers were killed in the Malaysia Airlines Flight 17 in July.

2015

- New, aggressive strain of HIV discovered in Cuba Researchers at the University of Leuven in Belgium say the HIV strain CRF19 can progress to AIDS within two to three years of exposure to virus. Typically, HIV
takes approximately 10 years to develop into AIDS. The researchers found that patients with the CRF19 variant had more virus in their blood than patients who had more common strains. Patients with CRF19 may start getting sick before they even know they've been infected, which ultimately means there's a significantly shorter time span to stop the disease's progression. The researchers suspect that fragments of other subsets of the virus fasten to each other through an enzyme which makes the virus more powerful and more easily replicated in the body, thus the faster progression.

2016

- Researchers have found that an international study found that almost 2,000 patients with HIV failed to respond to the antiviral drug known as Tenofovir disoproxil. Tenofovir is the main HIV drug treatment. The failure to respond to treatment indicates that the virus' resistance to the medication is becoming increasingly common.
- The United Nations holds its 2016 High-Level Meeting on Ending AIDS. The countries involved, the member states of the United Nations, pledge to end the AIDS epidemic by 2030. There was significant controversy surrounding the event as over 50 countries blocked the access of LGBTQ+ groups from participating in the meeting. At the conclusion of the meetings, which ran from June 8–10, 2016, the final resolution barely mentioned several groups that are most affected by HIV/AIDS, men who have sex with men, transgender people, people who inject drugs, and sex workers.

**Timeline of Norse colonization of the Americas**

**Prehistoric settlement**

- **16,000 years before present:** In the 20th century it was generally believed that humans had crossed a land bridge from Eurasia perhaps 12,000 years ago — the 'Clovis First / Single origin hypothesis' — but modern scientific belief is that settlers arrived by boat at least 14,000-16,000 years before present.

**Norse colonization**

- **c. 1000:** Erik the Red and Leif Ericson, Viking navigators, discovered and settled Greenland, *Helluland* (possibly Baffin Island), *Markland* (now called Labrador), and Vinland (now called Newfoundland). The Greenland colony lasted until the 15th century.
- **c. 1350:** The Norse Western Settlement in Greenland was abandoned.
- **1354**: King Magnus of Sweden and Norway authorised Paul Knutson to lead an expedition to Greenland which may never have taken place.

- **c.1450–1480s**: The Norse Eastern Settlement in Greenland was abandoned during the opening stages of the Little Ice Age.

**Timeline of the BBC**

**1920s**

- **1922**
  - 18 October – The British Broadcasting Company is formed.
  - 14 November – First BBC broadcasts from London (station 2LO).
  - 15 November – First broadcasts from Birmingham (station 5IT) and Manchester (station 2ZY).
  - 24 December – First broadcast from Newcastle upon Tyne (station 5NO).

- **1923**
  - 8 January – First outside broadcast, the British National Opera Company's production of *The Magic Flute* from Covent Garden.
  - 18 January – The UK Postmaster General grants the BBC a licence to broadcast.
  - 13 February – First broadcast from Cardiff (station 5WA).
  - 6 March – First broadcast from Glasgow (station 5SC).
  - 6 June – Edgar Wallace makes a report on The Derby, thus becoming the first British radio sports reporter.
  - 28 September – First publication of the *Radio Times* listings magazine (price 2d).
  - 10 October – First broadcast from Aberdeen (station 2BD).
  - 17 October – First broadcast from Bournemouth (station 6BM).
  - 16 November – First broadcast from Sheffield (relay station 2FL).

- **1924**
  - 28 March – First broadcast from Plymouth (relay station 5PY).
23 April – First broadcast by King George V, opening the British Empire Exhibition at Wembley Stadium.

1 May – First broadcast from Edinburgh (relay station 2EH).

11 June – First broadcast from Liverpool (relay station 6LV).

8 July – First broadcast from Leeds and Bradford (relay station 2LS).

21 July – An experimental long-wave station (5XX) is established at the Chelmsford works of the Marconi Company.

15 August – First broadcast from Kingston upon Hull (relay station 6KH).

14 September – First broadcast from Belfast (station 2BE).

16 September – First broadcast from Nottingham (relay station 5NG).

21 October – First broadcast from Stoke-on-Trent (relay station 6ST).

12 November – First broadcast from Dundee (relay station 2DE).

12 December – First broadcast from Swansea (relay station 5SX).

1925

27 July – Long-wave station 5XX moves from Chelmsford to Daventry transmitting station and becomes the first British radio station to achieve near national coverage: the first step in the establishment of the BBC National Programme.

1926

4 May – The General strike begins. The BBC broadcasts five news bulletins a day as no newspapers or Radio Times are published.

1927

1 January – The British Broadcasting Company becomes the British Broadcasting Corporation, when it is granted a Royal Charter. Sir John Reith becomes the first Director-General.

15 January – First live sports broadcast on the BBC. The rugby union international England v Wales is commented on by Teddy Wakelam.

22 January – First live football match broadcast, featuring Arsenal's home league fixture against Sheffield United from Highbury.

January – First BBC reference library established by Florence Milnes.

March – The BBC coat of arms is adopted.
7 July – Christopher Stone presents a record programme, becoming the first British disc-jockey.

21 August – The first high-powered regional station (5GB), forerunner of the Midland Regional Programme, opens at Daventry.

**1928**

2 January – The first edition of The Daily Service is broadcast. It was originally called A Short Religious Service but was renamed The Daily Service in July.

**1929**

20 August – First transmissions of John Logie Baird's experimental 30-line television system.

**1930s**

**1930**

9 March – The majority of the BBC's existing radio stations are regrouped to form the BBC National Programme and the BBC Regional Programme.

14 July – Transmission of the first experimental television play, The Man With the Flower in His Mouth.

30 September – Number of radio licences reaches 12 million "or roughly every second home in the country".

**1931**

2 June – First live television outside broadcast with transmission of the Epsom Derby.

**1932**

15 March – The first radio broadcast is made from Broadcasting House.

15 May – Broadcasting House, the BBC’s headquarters and home to its main radio studios, is officially opened.

22 August – The first, experimental television broadcast is made from Broadcasting House.

19 December – The Empire Service (precursor of the World Service) launches, broadcasting on shortwave from Daventry's Borough Hill.
25 December – King George V becomes the first monarch to deliver a Christmas Day message by radio, on the Empire Service.

- **1933**
  - No events.

- **1934**
  - 7 October – The new high-power long-wave transmitter at Droitwich takes over from Daventry 5XX as the main station radiating the BBC National Programme.

- **1935**
  - No events.

- **1936**
  - 2 November – The BBC opens the world's first regular high-definition television service, from Alexandra Palace.

- **1937**
  - 24 April – The very first children's television show *For the Children*.
  - 12 May – First use of TV outside broadcast van, to cover the procession that followed the coronation of King George VI and Queen Elizabeth.
  - 21 June – The BBC broadcasts television coverage of the Wimbledon Tennis Championships for the first time.
  - 16 September – The BBC makes the world's first live television broadcast of a football match, a specially arranged local mirror match derby fixture between Arsenal and Arsenal reserves.

- **1938**
  - 3 January – The BBC begins broadcasting its first foreign-language radio service, in Arabic.
  - 30 April – The BBC broadcasts television coverage of the FA Cup for the first time.
  - 27 September – Start of the European Service on radio, broadcasting in French, German and Italian. Portuguese and Spanish are added before the start of the Second World War.

- **1939**
- Creation of BBC Monitoring
- 1 September – The BBC Television Service is suspended, about 20 minutes after the conclusion of a Mickey Mouse cartoon (*Mickey's Gala Premiere*), owing to the imminent outbreak of the Second World War and amid fears that the VHF transmissions would act as perfect guidance beams for enemy bombers attempting to locate central London. Additionally, the service's technicians and engineers will be needed for such war efforts as the development of radar. On radio, the National and Regional Programmes are combined to form a single Home Service.

### 1940s

<table>
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<tr>
<th>Year</th>
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| 1940 | 7 January – Start of the BBC Forces Programme on radio, precursor of the post-war Light Programme.  
11 May – The BBC starts a news service in Hindi. |
| 1941 | The BBC European Service moves to Bush House in Central London. |
| 1942 | 29 January – The first edition of *Desert Island Discs* is broadcast on the BBC Forces Programme. |
| 1943 | No events. |
| 1944 | 27 February – BBC General Forces Programme replaces the BBC Forces Programme (also broadcast on shortwave). |
| 1945 | 29 July – Regional radio programming resumes on the Home Service (on the same medium-wave frequencies as used pre-war by the Regional Programme), while on the same day a new Light Programme begins, using the long-wave frequency of the pre-war National Programme. |
9 October – The first edition of *Today in Parliament* is broadcast.

1946
- 7 June – BBC Television broadcasts (405 lines) resume after the war including the coverages of cricket and Wimbledon Tennis. One of the first programmes shown is the Mickey Mouse cartoon from 1939.
- 29 September – The Third Programme starts broadcasting on radio.

1947
- 7 October – Adelaide Hall singing at a RadiOlympia variety show is the oldest surviving telerecorded programme in Britain.
- 9 November – First use of telerecording of an outside broadcast: the Service of Remembrance from the Cenotaph is televised live, and a telerecording shown that evening.
- 20 November – The wedding of Princess Elizabeth and Philip Mountbatten, Duke of Edinburgh is televised by the BBC. It is watched by an estimated 400,000 viewers.

1948
- 29 July – The London Olympic Games is televised.
- 26 December – The first Reith Lecture is broadcast on radio.

1949
- "Briefe ohne Unterschrift" begins broadcast (1949 – 1974) Austin Harrison reads and comments letters by East Germans.
- 17 December – For the first time television extends beyond London when the Sutton Coldfield transmitter starts broadcasting, providing television reception across the Midlands.

1950
- 21 May – Lime Grove television studios open.
27 August – First live television from the European continent, using BBC outside broadcast equipment.

1951

1 January – First broadcast of The Archers, now the world's longest-running soap opera.

12 October – Television extends to the north of England following the switching on of the Holme Moss transmitting station.

1952

14 March – Television becomes available in Scotland for the first time following the switching on of the Kirk o'Shotts transmitting station.

15 August – Television becomes available in Wales for the first time following the switching on of the Wenvoe transmitting station.

1953

1 May – Television becomes available in Northern Ireland for the first time although initially from a temporary transmitter, brought into service in time for the Queen's Coronation. A permanent mast at Divis is brought into service in 1955.

2 June – The coronation of Queen Elizabeth II in Westminster Abbey is televised by the BBC and watched live by an estimated audience of 20 million people in the United Kingdom.

11 November – The first edition of Panorama is presented by Daily Mail reporter Pat Murphy. Panorama is the world's longest-running current affairs programme and retains a peak-time slot to this day.

Watch With Mother, the iconic pre-schoolers strand, debuts. It was replaced with the see saw branding in 1975.

1954

11 January – The very first in-vision weather forecast is broadcast, presented by George Cowling. Previously, weather forecasts had been read by an off-screen announcer with a weather map filling the entire screen.

5 July – BBC newsreader Richard Baker reads the first televised BBC News bulletin.

30 December – The first BBC Sports Personality of the Year award takes place.
1955
- 2 May – The BBC begins broadcasting its radio service on VHF (FM), using the Wrotham transmitter.
- September – Kenneth Kendall becomes the BBC’s first in-vision newsreader, followed by Richard Baker and Robert Dougall.
- 10 October – Alexandra Palace begins test transmissions of a 405-line colour television service.

1956
- 28 March – Television transmissions begin from the new Crystal Palace site in south London.
- The BBC broadcasts a trade test colour film for the first time.

1957
- 16 February - Six-Five Special first Rock and Roll programme first broadcast (16/2/57 - 27/12/58)
- The first broadcast of Test Match Special takes place, providing listeners with ball-by-ball cricket commentary for the first time.
- 24 April – The Sky at Night, a monthly astronomy programme presented by Sir Patrick Moore, is first broadcast.
- 24 September – The first programmes for schools are broadcast.
- September – The first broadcasts of regional news bulletins took place.
- 30 September – Launch of Network Three, a strand of adult-education broadcasts transmitted on the frequencies of the Third Programme in the early part of weekday evenings.
- 25 December – First TV broadcast of the Queen's Christmas Day message.

1958
- The BBC introduces a new 3 box system logo. The logo featured slanted lettering within upright boxes.
- 14 April — The newly magnetic videotape machine Vision Electronic Recording Apparatus or VERA for short, was given a live demonstration on-air in Panorama where Richard Dimbleby seated by a clock, talked for a couple of minutes...
about the new method of vision recording with an instant playback, and then the tape was wound back and replayed. The picture was slightly watery, but reasonably watchable, and instant playback was something completely new.

- 5 May – First experimental transmissions of a 625-line television service.
- 10 October – First broadcast of the United Kingdom's multi-sport television show Grandstand.
- 16 October – First broadcast of the United Kingdom's longest-running children's television show Blue Peter.

1959

- The BBC North East and Cumbria region is created with localised bulletins from Newcastle-upon-Tyne aired for the first time. Previously, the area was part of a pan-Northern region based in Manchester.

1960s

- 1960
  - 26 March – BBC Television televises the Grand National for the first time.
  - 19 June – Nan Winton becomes the BBC's first national female newsreader.
  - 29 June – BBC Television Centre opens.
  - 8 October – The BBC Television Service is renamed as BBC TV.

- 1961
  - No events.

- 1962
  - 4 January – Popular sitcom Steptoe and Son begins.
  - 27 June – The Pilkington Committee on Broadcasting publishes its report into the future of UK broadcasting. Long its recommendations are the introduction of colour television licenses, that Britain's third national television channel should be awarded to the BBC and that the BBC should extend its activities to the creation of local radio stations in order to prevent the introduction of commercial radio.
  - 28 August – Experimental stereo radio broadcasts begin.
The BBC runs a series of closed circuit experiments in local radio from a variety of locations across England.

1963
- The BBC Logo had to improve to slant the boxes with the lettering.
- 30 September – A globe is used as the BBC Television Service’s logo for the first time.
- 23 November – First broadcast of the world’s longest-running science fiction television programme, Doctor Who.

1964
- 1 January – First broadcast of Top of the Pops pop and rock music television show.
- 20 April – BBC2 starts broadcasting (on 625 lines). The existing BBC Television Service is renamed BBC1.
- 22 August – First broadcast of top flight football television show Match of the Day.

1965
- 22 March – Launch of the daytime BBC Music Programme on the frequencies of Network Three / the Third Programme.
- 1 May – The General Overseas Service is renamed the BBC World Service.
- 10 October – A new service for Asian immigrants begins broadcasting. The programming consists of a weekly television and radio programme broadcast on Sunday mornings.

1966
- 17 April – The first regular stereo radio transmissions begin, from the Wrotham transmitter.
- A government White Paper paves the way for the launch of a small number (eight) of two-year experimental BBC Local Radio stations.

1967
- 25 June – The first worldwide live satellite programme, Our World, featuring the Pop band, the Beatles, is televised.
- 1 July – Regular colour TV transmissions (625 lines) begin on BBC2, starting with the Wimbledon tennis championships.
30 September – BBC Radio 1 is launched, as a response to the threat from pirate radio station broadcasts of popular music. At the same time, the Light Programme, the third network (Network Three / the Third Programme), and the Home Service are renamed Radios 2, 3 and 4 respectively.

23 October – Service Information is broadcast for the first time.

8 November – The BBC launches its first local radio station when BBC Radio Leicester launches.

15 November – BBC Radio Sheffield launches.

22 November – BBC Radio Merseyside launches.

2 December – BBC2 becomes the first television channel in Britain to broadcast in colour.

1968

31 January – BBC Radio Nottingham launches.

14 February – BBC Radio Brighton launches.

14 March – BBC Radio Stoke launches.

25 March – BBC regional television from Leeds began and the first edition of Look North is broadcast. Previously, the Yorkshire area had been part of a wider North region based in Manchester.


3 July – BBC Radio Durham launches.

31 July –

- The first episode of Dad's Army is broadcast.
- BBC Radio Durham launches.

1969

10 July – The BBC publishes a report called "Broadcasting in the Seventies" proposing the reorganisation of programmes on the national networks and replacing regional broadcasting on BBC Radio 4 with BBC Local Radio.

9 September – The first edition of Nationwide is broadcast.

15 November – BBC1 starts broadcasting in colour (simultaneous with rival ITV). First appearance of the Mirror Globe, coloured blue on black.

BBC Local Radio is made permanent after the two-year experiment is judged to have been a success.

1970s

- **1970**
  - 4 April – BBC Radio’s sports coverage transfers from BBC Radio 3 to BBC Radio 2.
  - 14 September – Robert Dougall presents the first edition of the *BBC Nine O’Clock News*. The programme, launched in response to ITN’s *News at Ten*, was controversially moved to 10 pm in 2000.

- **1971**
  - The BBC logo's boxes rounds off the corners and increases the spaces.
  - The first programmes for the Open University are broadcast.
  - 26 January – BBC Radio Blackburn launches.
  - 29 April – BBC Radio Derby launches.

- **1972**
  - 4 April – The first edition of *Newsround* is broadcast.
  - 25 August – When the government restricted the BBC to twenty local radio stations, the corporation responds by closing BBC Radio Durham. Its resources are transferred to Carlisle where BBC Radio Carlisle, now BBC Radio Cumbria, was formed.
  - 2 October – Following a recent law change, BBC1 and ITV are allowed to begin broadcasting a full afternoon schedule with both broadcasters now broadcasting non-stop from lunchtime. BBC1’s afternoon schedule launches with the first edition of a new lunchtime magazine programme *Pebble Mill at One*. 
• 4 November – Radios 2 and 4 begin broadcasting in stereo in South East England. Stereo was rolled out to the rest of the country over subsequent years.

• 1973
  
o 4 January – The pilot episode of Last of the Summer Wine airs. The regular series, which begins on 12 November, becomes the longest-running sitcom in the world, running for 37 years.
  
o 24 August – BBC2 broadcasts a trade test colour film for the final time, having done so during daytime closedowns to provide colour broadcasting in these intervals for use by television shops and engineers (the 'trade') to adjust their television sets.
  
o 10 September – Newsbeat bulletins air on BBC Radio 1 for the first time.
  
o 24 November – BBC Radio Carlisle launches.
  
o 17 December - The British government imposes early close downs of all three television channels in the UK from 17 December 1973 in order to save electricity during the Three Day Week crisis. The early close downs forced BBC1 and BBC2 to end their broadcasting day at 10.30pm. The restrictions were lifted temporarily on Christmas Eve to allow the public to enjoy festive programming. The restrictions recommenced on Monday 7 January 1974. The restrictions ended on 8 February 1974.

• 1974
  
o 7 January – A two-minute mid-afternoon regional news summary is broadcast on BBC1 for the first time. It is transmitted immediately before the start of the afternoon's children's programmes.
  
o 1 April – BBC Radio Teesside is renamed BBC Radio Cleveland.
  
o 23 September – Teletext service Ceefax goes live.
  
o December – The BBC1 Mirror globe changes colour from blue on black to yellow on blue.

• 1975
  
o 1 January – BBC Radio Ulster is launched.
  
o 4 January - Due to cutbacks at the BBC, BBC Radio 2's broadcasting hours are cut back, with the station now starting their day at 6.00am instead of 5.00am, and their broadcasting day concluding at around 12.33am instead of 2.02am. Later in the autumn of 1975, BBC Radio 2 would end their day slightly earlier at around 12.10am, except on
Saturdays and Sundays when the station would continue until around 12.33am. These cutbacks would remain until 1978, however at Christmas 1975, 1976 and 1977 BBC Radio 2 hours were extended over the festive season.

- **6 January** – Due to these cutbacks, BBC1 stops broadcasting programmes on weekday early afternoons. Consequently, apart from schools programmes and live sport, the channel now shows a trade test transmission between 2pm and the start of children's programmes, and when not broadcasting actual programmes, BBC2 begins fully closing down on weekdays between 11.30am and 4pm.

- **1976**
  - September – The credits of each programme produced by the BBC reveals the copyrighted years in roman numerals for the first time.

- **1977**
  - 3 January – BBC Radio Cymru is launched.
  - 9 May – BBC Radio Orkney and BBC Radio Shetland launch as opt-out stations from BBC Radio Scotland.
  - 19 October – The first edition of a new weekly magazine programme for Asian women, Gharbar, is broadcast. The programme had only been intended to run for 26 weeks but continued for around 500 weeks, finally ending in April 1987.
  - 25 December – *The Morecambe & Wise Christmas Show* on BBC1 attracts an audience of more than 28 million, one of the highest ever in UK television history.

- **1978**
  - The BBC organises its first Young Musician of the Year competition.
  - 24 May – *Nationwide* airs the famous Skateboarding duck report.
  - 23 November –
    - All BBC national radio stations change their medium or long wave transmission wavelength as part of a plan for BBC AM broadcasting in order to improve national AM reception, and to conform with the Geneva Frequency Plan of 1975. Radio 1’s transmission wavelength is moved from 247m (1214 kHz) to 275 & 285m (1053 & 1089 kHz) medium wave. Radio 2’s wavelength is moved from 1500m (200 kHz) long wave to 433 & 330m (693 & 909 kHz) medium wave. Radio 3 is moved from 464m (647 kHz) to 247m (1215 kHz) medium wave.
Radio 4 is moved from various medium wavelengths to 1500m (200 kHz) long wave.

- The shipping forecast transfers from BBC Radio 2 to BBC Radio 4 so that the forecast can continue to be broadcast on long wave.
- The Radio 4 UK Theme is used for the first time to coincide with the network becoming a fully national service for the first time and to underline this the station officially becomes known as Radio 4 UK, a title that remains until mid 1984.

November – Due to Radio 4’s transfer from medium wave to long wave, BBC Radio Scotland and BBC Radio Wales launch as full-time stations on Radio 4’s former Scottish and Welsh medium wave opt-out wavelengths of 370m (810 kHz) and 340m (882 kHz) respectively, albeit initially with very limited broadcast hours due to very limited coverage of BBC Radio 4 on FM in both countries.

21–22 December – The BBC is crippled by its most famous 24-hour strike, which leads to record viewing figures for ITV. BBC1 and BBC2 television are off the air on 21 and 22 December. On 22 December the unions called out their radio colleagues on strike, meaning BBC Radio 1, 2, 3 and 4 were "collapsed" into one emergency "All Network Service" from 4.00pm until the end of their broadcasting day at 2.05am. The strike was settled by 10.00pm on 22 December with a pay increased awarded to BBC staff. BBC Television and Radio stations resumed normal broadcasting on 23 December.

1979

- 27 January – BBC Radio 2 closes down for the last time.
- 1 March – BBC2 unveils its computer generated ident, the first computer-generated ident in the world. The second such ident is unveiled by US broadcaster NBC.
- 27 August – The murder of Lord Mountbatten by the IRA sets a record audience of 26 million for a news bulletin. Strike action at ITN led to the record viewing figures.
- 11 September – BBC Radio Foyle launches as an opt-out station from BBC Radio Ulster.
- 25 September – The first edition of Question Time is broadcast.

1980s

1980

881
o 28 January – Newsnight is launched.

o February – BBC Radio Deeside is launched as an opt-out service from BBC Radio Wales.

o March – The very first in-vision Ceefax transmissions are broadcast. Three 30-minute transmissions are aired at various points during weekday daytime downtime.

o Summer – Due to the continued expansion of BBC Local Radio, regional opt-out programming on BBC Radio 4 ends, apart from in the south west as this is now the only part of England still without any BBC local station.

o 8 September – Watchdog is launched as a weekly slot on BBC1’s news magazine programme Nationwide.

o 11 September – BBC Radio Norfolk launches.

o September – Regional peaktime continuity on BBC1 ends and with it the weeknight closedown regional news bulletin.

o 11 November – BBC Radio Lincolnshire launches.

o 21 November – The charity appeal Children in Need is launched.

1981

o 17 May – Sunday Grandstand launches. It broadcasts during the summer months on BBC2.

o 4 July – BBC Radio Blackburn expands to cover all of Lancashire and is renamed accordingly.

o 29 July – The Wedding of Charles, Prince of Wales and Lady Diana Spencer is produced by BBC Television & Radio with an audience of 750 million viewers and listeners in over 60 countries. Welsh Actor Richard Burton and Scottish writer, actor & royal expert Tom Fleming are among the commentators.

o Autumn – BBC Micro is produced for BBC Computer Literacy Project.

o 4 September – The final edition of the Midday News is broadcast.

o 5 September – The BBC1 Mirror globe changes colour from yellow on blue to green on blue.

o 7 September – News After Noon is launched as a 30-minute lunchtime news programme, replacing the much shorter Midday News.
o October – BBC Radio Deeside is expanded to cover all of north east Wales and is renamed BBC Radio Clwyd.

o 23 October – The last ever teatime block of Open University programmes are transmitted. From the 1982 season, only a single Open University programme is aired at 5.10pm, ahead of the start of the channel's evening programmes.

o 23 November – BBC Radio Birmingham expands to cover the West Midlands, South Staffordshire, north Worcestershire and north Warwickshire and is relaunched as BBC WM.

**1982**

o March – The BBC proposes to launch a satellite television service following the Corporation being awarded two of the five DBS satellite channels.

o 15 and 16 March – BBC Local Radio starts broadcasting to the Channel Islands when BBC Radio Guernsey and BBC Radio Jersey launch.

o 1 May – BBC Radio Cambridgeshire launches.

o 25 May – BBC Radio Carlisle expands to cover all of Cumbria and is renamed accordingly and as part of the expansion, BBC Radio Furness launches as an opt-out service.

o 20 June – The BBC relaunches its Sunday morning programme for the Asian community when *Asian Magazine* replaces *Apna Hi Ghar Samajhiye* which had been on air since 1968.

o September – The BBC World Service becomes available to UK listeners for the first time, albeit only in south east England.

o 10 September – After 32 years on air, *Listen with Mother* is broadcast on BBC Radio 4 for the final time.

o 1 November – BBC-produced Welsh-language programming is transferred from BBC1 to the new S4C channel.

o 23 December – *Service Information* is broadcast for the final time.

o 31 December – The last remaining opt-out regional programming on BBC Radio 4 ends when the final edition of *Morning Sou'West* is broadcast, ahead of the launches of BBC Radio Devon and BBC Radio Cornwall.

**1983**
• January – BBC1 starts broadcasting a full afternoon service, consisting of regional programmes, repeats and old feature films.

• 17 January –
  • *Breakfast Time*, the UK’s first national breakfast television service, is launched, ahead of the ITV franchise TV-am, which follows on 1 February.
  • BBC Radio Devon and BBC Radio Cornwall launch.

• late February/early March – BBC1 begins broadcasting a 30-minute Ceefax slot prior to the start of *Breakfast Time*. It is called *Ceefax AM*. It is first mentioned in the *Radio Times* on 21 March.

• 18 April – BBC Radio Gwent launches as an opt-out service from BBC Radio Wales.

• 2 May – From today *Pages from Ceefax* is broadcast during all daytime downtime although BBC2 continues to fully close down for four hours after *Play School*. The broadcasts are still known as *Ceefax in Vision* and were not listed in the *Radio Times* until 7 January 1984 when they became known as *Pages from Ceefax*.

• 2 July – BBC Radio Medway is expanded to cover all of the county of Kent and is renamed accordingly.

• 4 July – BBC Radio York launches on a permanent basis – the station had been on air briefly the previous May to cover the visit to York of Pope John Paul II.

• 5 August – The final edition of *Nationwide* is broadcast.

• 16 September – BBC2 closes down during the day for the final time – all future daytime downtime is filled by *Pages from Ceefax*.

• 19 September – Programmes for schools and colleges are transferred to BBC2 and an all-day educational strand called *Daytime on Two* is launched. Consequently, the morning broadcast of *Play School* transfers to BBC1.

• 22 October – BBC Radio Brighton expands to cover all of Sussex and is renamed accordingly.

• 24 October – *Sixty Minutes* launches as the new evening news programme to replace *Nationwide*.

• Autumn – Shortly after the Home Secretary announced that the three remaining satellite channels would be given to the Independent Broadcasting Authority (IBA) to allow the private sector to compete against the BBC, the BBC starts talking with the IBA about a joint project to help cover the cost. The Government subsequently gives permission and a
consortium emerges consisting of the BBC, Granada, Anglia Television, Virgin, Thorn-EMI, Pearson Longman and Consolidated Satellite Broadcasting. The BBC holds a 50% stake in the consortium.

- **1984**
  - The BBC conducts five trials of citywide community stations in Greater Manchester. Each trial lasts for a few weeks and was on air for a few hours each day, opting out of BBC Radio Manchester. The experiment has not been repeated.
  - 27 July – The final edition of *Sixty Minutes* is broadcast.
  - 3 September – First broadcast of the *Six O'Clock News* on BBC1. The programme continues to this day.
  - 5 October – The last ever teatime Open University programme is broadcast on BBC2. However Open University programmes continue to be shown on BBC2 on weekday lunchtimes on an ad-hoc basis until 1988.
  - 8 October – BBC2 launches a full afternoon service, consisting of repeats of *Dallas* and old feature films.
  - 18 November – The BBC launches its first Sunday lunchtime political interview show, called *This Week, Next Week*. It is replaced in 1988 by *On the Record*.
  - December – BBC1 stops broadcasting a late night news summary.

- **1985**
  - 3 January – The last day of transmission using the 405 lines system.
  - 7 January – The BBC ends its experiment with afternoon broadcasting and from this date afternoon *Pages from Ceefax* is shown on BBC1 between the end of lunchtime programmes and the start of children's programmes, and on BBC2 Ceefax pages are shown continuously between 9am and 5.25pm apart from when *Daytime on Two* is in season and when sporting events are being shown.
  - 23 January – Television coverage of proceedings in the House of Lords begins.
  - 18 February – BBC1 is given a major relaunch, along with the introduction of a new ident, the COW (Computer Originated World). Also, computerised weather maps were used for the first time for all weather forecasts – prior to this date computerised maps had only been used during *Breakfast Time*.
  - 19 February – *EastEnders* premieres on BBC1.
March – The charity appeal Comic Relief is launched.

23 April – BBC Radio Shropshire launches.

May – The consortium which has been planning to launch satellite television in the UK, of which the BBC is part, collapses on costs grounds.

24 June – BBC Radio Bedfordshire launches.

13 July – Live Aid is broadcast to the world on BBC1 and BBC Radio 1, the first broadcast of its kind.

2 September – A regional news bulletin following the Nine O'Clock News is launched.

9 September – The weekday afternoon block of children's programming is rebranded as Children's BBC, and for the first time the children's block has dedicated idents and an in-vision presenter. Previously children's programming had been introduced by BBC1's team of regular duty announcers.

1 October – BBC Radio nan Gàidheal launches.

- 1986

30 March – BBC2 receives a new look with the word TWO.

1 April – All commercial activities of the BBC are now handled by BBC Enterprises Ltd.

24 October – The final edition of News After Noon is broadcast.

27 October – BBC1 starts a full daytime television service. Among the new programmes is a new lunchtime news bulletin – the One O'Clock News. The programme continues to this day. Before today, excluding sport and special events coverage, BBC1 had closed down at times during weekday daytime, broadcasting trade test transmissions and, from May 1983, Pages from Ceefax. BBC2 also expands its programming hours, providing a full afternoon service but it wasn't until the end of the decade that BBC2 was on air all day every day.

5 November – BBC Essex launches.

8 December – Six weeks after launching its daytime service, BBC TV starts broadcasting hourly news summaries. Morning bulletins are shown on BBC1 and early afternoon summaries (at 2 pm, 3 pm and 3:50 pm) are shown on BBC2. Each bulletin is followed by a weather forecast.
o 28 December – After more than 20 years, BBC radio's national programme for the Asian community, *Apna Hi Ghar Samajhiye* (Make Yourself at Home), and broadcast on Sunday morning on BBC Radio 4, ends.

**1987**

o The BBC World Service launches *BBC 648* from the Orfordness transmitting station. The service provides a tailor-made service for northern Europe featuring some French and German programming programmes interwoven with the main output in English.

o 28 April – BBC television programming in Hindi and Urdu ends after more than 20 years. Three months later, on 25 July, a new English language programme for the Asian community launches.

o 22 June – The BBC's lunchtime children's programme moves from BBC1 to BBC2. It is shown slightly earlier, at 1:20 pm.

o 31 October – BBC Radio 1 starts broadcasting on VHF in London.

**1988**

o 11 April – BBC Somerset Sound launches as an opt-out station from BBC Radio Bristol.

o 9 May – The BBC launches a youth strand on BBC2 called DEF II.** 1 September –

  ▪ BBC External Services is renamed the World Service.

  ▪ Radio 1 starts regular broadcasts on VHF/FM in Scotland, northern England, the Midlands, and south Wales, Avon and Somerset. FM coverage is rolled out across the rest of the UK in stages over the next few years.

o 20 September – The Radio Data System (RDS) launches, allowing car radios to automatically retune, display station identifiers and switch to local travel news.

o 3 October – BBC Radio Gloucestershire launches.

o 7 October – BBC Radio London stops broadcasting and is replaced on 25 October by BBC GLR.

o 30 October –

  ▪ The Asian Network launches as a 70 hours-a-week service on the MW transmitters of BBC Radio Leicester and BBC WM.

  ▪ BBC Radio Manchester is relaunched as BBC GMR.
Autumn – The BBC takes its first tentative steps into later closedowns – previously weekday programmes ended no later than 12:15 am and weekend broadcasting had finished by 1:30 am.

Regular late evening weeknight programming starts to appear on BBC Local Radio. The programming tends to be regional rather than local with the same programme networked on several local stations. Consequently, stations are now starting to provide local/regional programming on weeknights until midnight. Previously stations had ended local programming by mid-evening, handing over to BBC Radio 2 until the following morning.

- 1989
  - 14 February – BBC Hereford and Worcester launches.
  - 4 March – BBC Wiltshire Sound launches.
  - 1 April – The BBC launches BBC TV Europe, a subscription-based pan-European television station.
  - May – The BBC Night Network is launched on the BBC’s six local radio stations in Yorkshire and north east England. The service broadcasts seven nights a week from 6.05pm (6pm at the weekend) until 12midnight. Two years later the service is expanded to include the BBC’s four stations in the north west.
  - 19 June – For the first time, BBC2 broadcasts during the morning when not showing Daytime on 2. Programmes begin at 10 am, as opposed to lunchtime.
  - 29 September – The final edition of Breakfast Time is broadcast.
  - 2 October – The first edition of BBC Breakfast News is broadcast.
  - 21 November – Television coverage of proceedings in the House of Commons begins.

1990s

- 1990
  - 17 January – BBC CWR launches.
  - 25 March – At 7 pm BBC Radio 2 becomes available on FM 24/7 for the first time after the final ever ‘borrow’ of its FM frequencies by BBC Radio 1.
  - 12 April – BBC Radio Suffolk launches.
• 27 August – BBC Radio 5 begins broadcasting on BBC Radio 2's MW frequencies. BBC Radio's sports coverage transfers to the new station from Radio 2 and educational and children's programmes transfer from Radio 4 FM. Consequently, BBC Radio 2 becomes the first national BBC station to broadcast exclusively on FM and the full BBC Radio 4 schedule becomes available on FM for the first time.

• 5 September – The new BBC building at White City opens.

• 1991

• 7 January – The BBC East Midlands region is created and the first edition of East Midlands Today is broadcast.


• 16 February – BBC1 and BBC2 receive new idents generated from laserdisc, BBC1 with a '1' encased in a swirling globe, and BBC2 with eleven idents based around the numeral '2'.

• 2 March – Radio 4 News FM closes and BBC Radio 4 returns to FM.

• 11 March – The BBC launches its first global television station – BBC World Service Television. In Europe it replaces BBC TV Europe.

• March – After nearly eight years on air, BBC Radio Gwent closes.

• 1 April – The BBC becomes the statutory authority for issuing television licences, assuming the responsibility of licence fee collection and enforcement.

• 15 April – The World Service Television News service is launched. Unlike World Service radio which is funded by direct grant from the Foreign and Commonwealth Office, WSTV is commercially funded and carries advertising, which means that it cannot be broadcast in the UK.

• 1 May – BBC Radio 1 begins 24-hour transmission, but only on FM – Radio 1's MW transmitters still close down overnight, between 12 midnight and 6 am.

• 31 July – The BBC's Lime Grove Studios close.

• 31 August – BBC television starts officially broadcasting in stereo using the NICAM system. (Some transmitters had been broadcasting in stereo since 1986, but these were classified as tests.)
o 16 September – The main BBC Radio 4 service moves from long wave to FM as FM coverage has now been extended to cover almost all of the UK – Radio 4 didn't become available on FM in much of Scotland and Wales until the start of the 1990s. Opt-outs are transferred from FM to long wave.

o 14 October – World Service TV launches its Asian service.

o 14 November – BBC Radio Surrey launches.

- **1992**
  
  o 21 January – BBC Select is launched as an overnight subscription service and BBC Radio Berkshire launches.
  
  o 29 February – BBC Radio 3 ceases broadcasting on medium wave (AM).
  
  o 17 April – BBC Radio Nottingham ends transmissions on one of its MW transmitters. BBC Radio Cleveland, BBC Radio Northampton and BBC Radio Oxford also stop broadcasting on MW.
  
  o 1 November – The satellite TV channel UK Gold, run by the BBC with Thames Television, starts broadcasting.
  
  o BBC Local Radio stations start broadcasting the BBC World Service rather than BBC Radio 2 when not on air.

- **1993**
  
  o 5 April – BBC Radio Bedfordshire expands to cover the counties of Buckinghamshire and Hertfordshire and is renamed BBC Three Counties Radio.
  
  o 13 April – For the first time all BBC News programmes have the same look following a relaunch of all of the main news bulletins.
  
  o 26 April – BBC Dorset FM launches as an opt-out service from BBC Radio Devon.
  
  o Autumn – BBC GLR stops broadcasting on MW. Also, BBC GMR stops broadcasting on MW.
  

- **1994**
  
  o 27 March – BBC Radio 5 ends transmission.
  
  o 28 March – BBC Radio 5 Live, a dedicated news and sport network, starts round-the-clock broadcasts.
- 13 April – First BBC website created for the BBC2 series The Net. This is followed a month later by the launch of the subscription-based BBC Networking Club.
- 23 May – The BBC2 youth strand DEF II comes to an end after six years.
- 1 July – BBC Radio 1 ceases broadcasting on medium wave (AM) at 9 am.
- July – Arabic Television television service launched with funding from the Saudi Arabian Mawarid Group.
- 1 August – BBC Radio Surrey and BBC Radio Sussex merge to form BBC Southern Counties Radio.
- 19 September – The BBC launches a weekday lunchtime business, personal finance and consumer news programme. Called Working Lunch, the programme is broadcast on BBC2 for 42 weeks each year.

**1995**
- 16 January – BBC World Service Television was renamed as BBC World it was launched as an international free-to-air news channel on 26 January at 19:00 GMT.
- 30 January – BBC Prime launches as a local encrypted variety and light entertainment channel by BBC Enterprises.
- May – BBC Radio CWR closes as a stand-alone station and becomes an opt-out of BBC Radio WM.
- 9 October – BBC Learning Zone is launched.
- BBC Enterprises, the BBC's commercial arm, is restructured as BBC Worldwide Ltd.

**1996**
- March – BBC Dorset FM closes and is replaced by a rebroadcast of BBC Radio Solent with localised news bulletins.
- 9 April – BBC Radio Oxford and BBC Radio Berkshire merge to form BBC Thames Valley FM.
- 21 April – Arabic Television closes down when the Saudi backer pulls out following a row over coverage of the execution of a princess accused of adultery.
- 7 June – The BBC is restructured by the Director-General, John Birt. In the new structure BBC Broadcast will commission programmes, and BBC Production will make them.

- 13 October – BBC Television's long standing coverage of Formula One ends following ITV's acquisition of the rights from 1997 onwards (Formula One returns to the BBC in 2009). This is one of several high profile sports rights that the BBC loses at around this time. These include losing the rights to the FA Cup and England football internationals to ITV and England rugby union internationals to Sky.

- 4 November – The Asian Network expands into a full-time station when it increases the number of hours on air from 80 hours a week to 126 hours a week (18 hours a day). The station, which broadcasts on the MW frequencies of BBC Radio Leicester and BBC WM, is renamed BBC Asian Network. Consequently, Radios Leicester and WM become FM only stations.

- 29 December – What was billed as the last ever episode of Only Fools and Horses before the new millennium is watched by 24.35 million viewers, the largest ever TV audience for a sitcom.

- During 1996, www.bbc.co.uk becomes the home of the Corporation's online activities.

- **1997**

  - The BBC broadcasts the much praised "Perfect Day" corporate advertisement, featuring 27 artists singing lines of Lou Reed's original. The song later becomes a fund-raising single for Children in Need.

  - 28 February – The BBC sells its transmitters and transmission services to Castle Transmission Services for £244 million, to help fund its plans for the digital age.

  - March – The BBC and Flextech agree on a deal to provide several BBC-branded channels – BBC Showcase, for entertainment; BBC Horizon, for documentaries; BBC Style, for lifestyle; BBC Learning, for schools, and BBC Arena, for the arts – plus three other channels: BBC Catch-Up, for repeats of popular programmes within days of their original transmission, a dedicated BBC Sport channel and a TV version of Radio 1.

  - 6 September – The funeral of Diana, Princess of Wales is broadcast on BBC Radio & Television and aired to over 200 countries worldwide. Nearly 3 billion viewers and listeners watch the ceremonies. In the US, BBC's coverage is aired on A&E and CSPAN Cable Networks. David Dimbleby hosts the coverage with Tom Fleming narrating the service inside Westminster Abbey.
4 October – Current corporate identity adopted. At a reported cost of £5m the new logo was introduced due to the increase in digital services, as it is designed to be more visible at small size it is better suited for use in websites and on screen "DOGs." On Screen Identities changed, with BBC One adopting the Balloon Idents, and BBC Two retaining their 2's used from 1991, with new legend.

4 November – BBC News Online, a web-based news service, launches.

8 November – BBC One closes down for the very last time as from the following day, BBC News 24 broadcasts during the channel's overnight hours.

9 November – BBC News 24, the Corporation's UK television news service, launches at 17.30.

December – BBC Online is officially launched.

1998

February – Sunday Grandstand becomes a year-round programme. Previously it had only broadcast between May and September.

August – The BBC's domestic TV channels become available on Sky Digital's satellite service. An unintended consequence of this is that people in the rest of Europe can now watch BBC One and Two, using viewing cards from the UK, as the signal is encrypted for rights reasons. This applies even within the UK: people in England can now watch BBC channels from Scotland, Wales and Northern Ireland, and vice versa.

23 September –

- The BBC launches BBC Choice, its first new TV channel since 1964, available only on digital TV services.

- Following its purchase of the cable-only Parliamentary Channel, the BBC launches BBC Parliament on digital satellite and analogue cable with an audio feed of the channel on DAB.

15 November – Public launch of digital terrestrial TV in the UK.

BBC Radio 5 Live replaces the BBC World Service as BBC Local Radio's overnight downtime filler.

1999

BBC 648, which provided French and German language content for northern Europe from the Orfordness transmitting station, ends with the closure of the BBC's German
service. – the French for Europe service had closed in 1995. Consequently, all programming from this transmitter was in English only.

- 10 May – BBC network news relaunched with new music, titles and a red and ivory set. This design was used for the 25 October relaunch of News 24, enhancing cross-channel promotion of the service.
- 20 May – The BBC's digital teletext service starts.
- 1 June – BBC Knowledge starts broadcasting on digital services.
- 20 June – The BBC broadcasts live cricket for the final time when it shows live coverage of the 1999 Cricket World Cup Final, bringing to an end of sixty years of continuous cricket coverage on the BBC. The terrestrial rights transfer to Channel 4.

2000s

- 2000
  - 25 March – BBC GLR closes and is relaunched as BBC London Live 94.9.
  - 20 May – Due to the loss of many major sports rights in recent years, the BBC does not broadcast this week's edition of Grandstand – ITV was showing the FA Cup Final. Apart from when Christmas Day fell on a Saturday or a major national event taking place, this had been the first time that Grandstand had not been broadcast on a Saturday afternoon since the programme's inception in 1958.
  - 15 September – Final edition of Breakfast News on BBC One and BBC News 24, the last conventional news broadcast in the morning.
  - 2 October – The first edition of BBC Breakfast is broadcast, the new morning show on BBC One and News 24 from 6:00–9:30. (9:00 on BBC News 24).
  - 13 October – Final edition of the BBC Nine O'Clock News on BBC One.
  - 16 October – The BBC Ten O'Clock News launches on BBC One amid controversy, having been moved from 9 pm to cash in on the axing of ITN's News at Ten the previous year.
  - 16 October – Oxfordshire, once part of the South East, becomes part of South Today.
2001

- 3 March – A bomb explodes outside Television Centre. The blast was later attributed to dissident Irish Republican terrorists and it is suggested the BBC Panorama programme which named individuals as participants in the Omagh bomb was the motive.

- 3 September – As part of a major reorganisation of the BBC's south east region, Kent and Sussex get their own news programme, South East Today, replacing Newsroom South East.

- 1 October – BBC London News is launched as a London-only news programme.

- October – BBC Three Counties Radio launches opt-out programming for the county of Buckinghamshire.

- 5 November – BBC 2W is launched, broadcasting on digital services in Wales on weekday evenings.

- 19 November – Last showing of the then-current BBC Two idents. These set of idents would have ended in 1997 with BBC One's ident change but due to popularity the 1991 idents continued only with a new BBC logo and some newer ident sets. The new idents were Ivory 2's, interacting in a yellow world, with Purple box logo, the first BBC Channel to have one.

2002

- 2 February – BBC Radio 5 Live Sports Extra is launched.

- 11 February – The CBBC and CBeebies channels begin broadcasting.

- 2 March – BBC Four is launched at 19:00 in a simulcast with BBC Two. It replaces BBC Knowledge.

- 11 March – BBC 6 Music is launched.

- 29 March – BBC One rebrands with the controversial Rhythm and Movement Idents, including dancers in red dancing in different locations. The red box logo was also used for these idents. For the first time in 39 years, a globe is not included in the presentation.

- 16 August – BBC Radio 1Xtra is launched.

- 28 October – BBC Asian Network launches as a national station.

- 30 October – BBC Parliament launches on digital terrestrial television, having previously only been available as an audio-only service. However capacity limitations mean that the picture is squeezed into just one quarter of the screen.
11 November –
- The first edition of East Yorkshire and Lincolnshire edition of *BBC Look North* is broadcast, while the Leeds-based *Look North* programme now covers West, North and South Yorkshire and the North Midlands.
- BBC Radio Swindon outputs from the renamed BBC Radio Wiltshire begin.

15 December – BBC Radio 4 Extra is launched as BBC7.

**2003**
- 9 February – BBC Three is launched at 19:00 in a simulcast with BBC Two. It replaces BBC Choice.
- 8 December – BBC News 24 is relaunched with a new set and titles, as well as a new Breaking News sting. Networked news on BBC One and Two remains with the same titles though the set was redesigned in a similar style to that of the new News 24.

**2004**
- 28 January – Publication of the Hutton Inquiry, and subsequent resignation of the Chairman Gavyn Davies.
- 30 January – Resignation of the Director General, Greg Dyke. Mark Byford takes over as acting Director General.
- 16 February – Network news titles are relaunched in the style of BBC News 24, introduced two months earlier.
- 17 May – Appointment of Michael Grade as new Chairman.
- 21 May – Appointment of Mark Thompson as new Director General.
- 1 October – BBC Technology, incorporating the BBC's Broadcast Engineering division, is sold to Siemens AG Business Services for approximately £200m, and a £2bn, 10-year outsourcing contract.

**2005**
- 20 March – Mark Thompson announces staff of 27,000 to be cut by 3,780.
- 26 March – *Doctor Who* returns to the air, sixteen years after the last full series was broadcast.
- 23 May – Over one third of staff join strike in response to job cuts, dropping programmes.
1 August – BBC Broadcast, formerly Broadcasting & Presentation and responsible for the playout and branding of all BBC Channels, is sold to Creative Broadcast Services, owned by the Macquarie Capital Alliance Group and Macquarie Bank. It is renamed Red Bee Media on 31 October.

3 November – BBC Coventry & Warwickshire returns as a stand-alone station.

December – The Czech and Polish sections of the BBC World Service cease to exist. Eight other sections are to follow soon.

2006

3 April – BBC GMR changes its name back to BBC Radio Manchester.

23 April – The "Radio 4 UK Theme" is used for the final time. It is replaced by a news bulletin.

27 May – The BBC's first scheduled HDTV broadcast on BBC HD

14 August – The One Show is first broadcast on BBC One, initially as a four-week trial. It is seen as a modern-day version of highly popular series Nationwide with the programme resulting in popular journalism returning to BBC One's early evening schedule. The programme returned on a permanent basis the following July.

1 September – BBC Entertainment replaces BBC Prime in global markets.

7 October – BBC One rebrands from the Rhythm and Movement idents to the current "Circle" Idents, which acts as a link to the classic globe icon used for almost 40 years and as a symbol of unity.

13 November – BBC Parliament broadcasts in full screen format for the first time on the Freeview service, having previously only been available in quarter screen format. The BBC eventually found the bandwidth to make the channel full-screen after receiving "thousands of angry and perplexed e-mails and letters", not to mention questions asked by MPs in the Houses of Parliament itself

28 November – Resignation of Chairman Michael Grade, to join ITV.

1 December – BBC HD channel is officially launched after around eighteen months of trial broadcasts.

16 December – After more than 35 years, BBC Two airs the final Open University course-related television broadcast. With Open University course content now available through media such as podcasts and DVDs it is deemed no longer necessary for the programmes to be aired on television. However, the Open University continues to
make programming for a broader audience, with series including *Coast* and *Child of Our Time*.

- **31 December** – The BBC’s then-current Royal Charter and Agreement expires.

- **2007**
  - **22 January** – BBC News 24 is relaunched with new titles and new Astons.
  - **28 January** – The final edition of *Grandstand* is broadcast.
  - **18 February** – BBC Two rebrands from the yellow 2's, to the Window on the World 2's.
  - **July** – BBC Knowledge launched as a global channel by BBC Worldwide.
  - **11 August** – BBC Radio Cleveland is rebranded as BBC Tees due to its broadcasting area no longer being associated with the name Cleveland.
  - **3 September** – CBBC identity relaunched, with its third marketing campaign since the launch of the CBBC Channel.
  - **20 October** – BBC Switch, a teenage block of shows is launched to cater for the under-served 12- to 16-year-olds, launches.
  - **3 December** – BBC Somerset Sound is rebranded as BBC Somerset and becomes available on FM for the first time.
  - **25 December** – BBC iPlayer, an online service for watching previously aired shows, is launched.

- **2008**
  - **22 January** – BBC Three has its identity relaunched, showcasing new shows such as *Lily Allen and Friends*.
  - **11 March** – BBC Arabic Television launches.
  - **21 April** – BBC News 24 and BBC World are renamed BBC News and BBC World News respectfully.
  - **19 September** – BBC Alba, a Scottish Gaelic language digital television channel, launched through a partnership between BBC and MG Alba.

- **2009**
  - **2 January** – BBC 2W closes.
  - **14 January** – The BBC's Persian language TV channel is launched.
30 March – BBC Southern Counties Radio closes resulting in the return of BBC Surrey and BBC Sussex as stand-alone separate stations.

4 April – BBC Radio Swindon, which had opted out of BBC Radio Wiltshire, is closed. The two stations are merged as BBC Wiltshire.

2010s

- **2010**
  - 19 February – *EastEnders* celebrates 25 years with a special live edition, where the murderer of Archie Mitchell is revealed. Over 16 million viewers tuned in to find Stacey Slater to be the killer.
  - 30 July – BBC Two broadcasts its final *Working Lunch*.
  - 3 November – BBC One HD; a high-definition simulcast of a national version of BBC One is launched across all digital platforms.
  - 18 December – BBC Switch is switched off.

- **2011**
  - 27 March – Due to budget cuts, transmission of the BBC World Service on 648 kHz MW ends. The transmissions, from the Orfordness transmitting station in Suffolk, had been on air since 1982 and had provided coverage of the World Service to much of northern Europe.
  - 2 April – BBC7 is relaunched as BBC Radio 4 Extra.

- **2012**
  - 7 March – Brighton moves from South region, to South-East region, after the Meridian digital switch-over.
  - May – BBC Somerset launches as a full-time station.
  - 12 July – The BBC World Service relocates to Broadcasting House after 70 years at Bush House.
  - 27 July-12 August – The 2012 Summer Olympics take place and with the exception of news programming BBC One is devoted entirely to live coverage of the Games and BBC Radio 5 Live operates a temporary station – *5 Live Olympics Extra* – to provide additional coverage of the Games.
17 August – BBC Radio Kent, BBC Radio Lincolnshire, BBC Radio Merseyside and BBC Radio Nottingham stop broadcasting regular programmes on medium wave. It's part of a five-week trial to find out if listeners will miss or complain about the lack of AM services. At the end of the trial, the BBC decides that BBC Radio Nottingham's MW transmitter and Radio Kent's relay at Rusthall near Tunbridge Wells, will remain off-air.

17 September – George Entwistle is appointed as Director-General.

3 October – Broadcast of *Exposure: The Other Side of Jimmy Saville* which uncovered allegations of sexual abuse by Jimmy Savile.

23 October –
- The BBC's teletext service Ceefax is switched off following all regions switching to digital broadcasting. The very last *Pages from Ceefax* transmission had taken place two days earlier.
- BBC One Northern Ireland commences broadcasting in HD.

10 November – George Entwhistle resigns as Director-General, to be replaced temporarily by Tim Davie. Entwistle's 54-day tenure as Director-General is the shortest in the Corporation's history.

14 November – 90th anniversary broadcast at 17:33.

22 November – Tony Hall is announced as the new Director-General, taking the post in March 2013.

21 December – CBBC and CBeebies both air on BBC One for the last time.

At the end of 2012 the BBC loses the rights to show horse racing. This brings to an end a relationship between the BBC and televised horse racing which dates back to the 1950s.

2013

4 January – CBBC and CBeebies both air on BBC Two for the last time.

7 January – The debut of a national networked evening programme on BBC Local Radio, hosted by former Classic FM presenter Mark Forrest. The show, introduced as part of cost-cutting measures, replaces all local programming, apart from local sport coverage.

14 January – BBC One Scotland commences broadcasts in HD.

29 January – BBC One Wales commences broadcasts in HD.
o 26 March – BBC Two commences broadcasting in HD following the closure of BBC HD.

o 31 March – BBC Television Centre closes in Shepherd's Bush with the majority of TV services moved to Broadcasting House in central London.

o 5 April – BBC Monitoring moves to Licence Fee funding.

o 8 July – After eight years, BBC Local Radio returns to Dorset when a breakfast show for the county, as an opt-out from BBC Radio Solent, is launched.

o 25 October – The BBC hosts 100 Women, a day of debate and discussion across radio, television and online featuring a hundred women from around the world.


- **2014**
  
  o The BBC broadcasts the much praised "God Only Knows" corporate advertisement, featuring 21 artists singing lines of The Beach Boys' original. The song also became a fund-raising single and an advertisement for BBC Music for the first time since "Perfect Day" in 1997 for Children In Need.

  o 6 March – The BBC announce that BBC Three will become internet-only from February 2016, in an effort to save £90m. Their plans were approved on 26 November 2015.

  o 30 August – Rona Fairhead becomes the first woman to be appointed as Chair of the BBC Trust.

- **2015**
  
  o 6 October – After 27 years, the name BBC Radio London returns to the airwaves following a name change from BBC London 94.9.

- **2016**
  
  o 16 February – BBC Three closes as a linear channel and becomes an over-the-top Internet television service although all of the long-form programmes commissioned for BBC Three are to be shown at a later date on BBC One.

  o 19 February – BBC Radio Bristol stops broadcasting on MW following the sale of the land on which the transmitter was located, to developers.
31 March – BBC Three fully closes down on all digital television platforms – it had carried promotional information regarding the BBC Three internet service since 16 February.

11 April – CBBC extends its broadcast hours from 7 pm to 9 pm, using capacity which had previously been used by BBC Three.

2017

2 April – The BBC Trust is closed at the expiry of the 2007 Royal Charter, which had a 10-year lifespan. The Trust is replaced by the BBC Board.

2018

15 January – The MW transmissions of BBC Radios Sussex, Surrey, Humberside, Wiltshire, Nottingham, Kent and Lincolnshire end and MW coverage for BBC Devon, Lancashire and Essex is reduced. Altogether a total of 13 MW transmitters are switched off.

28 January – After nearly 78 years on air, The Sunday Hour is broadcast on BBC Radio 2 for the final time.

8 May – Another long running BBC Radio 2 programme ends when, ahead of schedule changes, The Organist Entertains is broadcast for the final time after 49 years on air.

24 October – The FM frequency of BBC Radio 3 at more than 30 relay transmitters in Wales is reallocated to BBC Radio Wales. Consequently, the reach of Radio Wales on FM increases from 79% to 91% but Radio 3’s FM availability in Wales falls to 92%.

1 November – BBC Sounds is launched.

29 November – HD versions of BBC Two Wales and BBC Two Northern Ireland start broadcasting.

2019

17 February – Ahead of the launch of BBC Scotland, BBC Two Scotland closes.

19 February – Virgin Media becomes the first platform to stop broadcasting some BBC channels in standard definition when it removes the standard definition feeds of BBC Four, BBC News, CBBC and CBeebies.

24 February – BBC Scotland launches. It broadcasts between 7:00 p.m. and midnight and includes an hour-long 9:00 p.m. newscast called The Nine. Between noon and 7:00 p.m., the channel simulcasts BBC Two but with BBC Scotland continuity, thereby
accommodating the daytime sport and politics programming opt-outs which had been displaced following the closure of BBC Two Scotland.

- 18 November – The BBC announces plans to close its red button text service by the end of 30 January 2020.

2020s

- 2020
  - 15 January – The BBC announces a further switching off of MW transmitters. The switch-offs, being done as a cost-cutting measure, will see the end of MW transmissions of Radios Cornwall, Newcastle, Merseyside, Solent, Solent for Dorset, BBC Three Counties Radio and BBC Radio York. Also, BBC Radio Cumbria will stop broadcasting on MW in Whitehaven and BBC Radio Norfolk's Norwich MW transmitter will go silent. In addition, BBC Radio Scotland will stop broadcasting on MW in Aberdeen and BBC Radio Wales will lose some MW coverage in central Wales. A total of 18 MW transmitters are to go. The transmitters will broadcast a retune advice loop prior to full switch-off in early April.
  - 29 January – The BBC announces that it has suspended its plan to switch-off the BBC Red Button service, one day before the service was due to have started being phased out. The announcement comes following a petition, organised by the National Federation of the Blind of the UK (NFBUK), which was submitted to the BBC and Downing Street – following protests.

Timeline of Jewish history

c. 1312 BCE

the Exodus from Egypt (Moses)

c. 1250 BCE–c. 1025 BCE

  Biblical judges lead the people

c. 1025 BCE–c. 1010 BCE

  King Saul
c. 1010 BCE–c. 970 BCE
King David

c. 970 BCE–c. 931 BCE
King Solomon

c. 960 BCE
Solomon's Temple in Jerusalem completed

c. 931 BCE
Split between Kingdom of Israel (Samaria) and the Kingdom of Judah

c. 931 BCE–c. 913 BCE
King Rehoboam of Judah

c. 931 BCE–c. 910 BCE
King Jeroboam of Israel

840 BCE
Mesha inscription describes Moabite victory over a son of King Omri of Israel.

c. 740 BCE–c. 700 BCE
Prophecy of Isaiah

c. 740 BCE–c. 722 BCE
Kingdom of Israel falls to Neo-Assyrian Empire

c. 715 BCE–c. 687 BCE
King Hezekiah of Judah

649 BCE–c. 609 BCE
King Josiah of Judah institutes major reforms

c. 626 BCE – c. 587 BCE
Prophecy of Jeremiah

597 BCE
First deportation to Babylon

586 BCE
Jerusalem falls to Nebuchadnezzar and Solomon's Temple destroyed
539 BCE
   Jews allowed to return to Jerusalem, by permission of Cyrus

520 BCE
   Prophecy of Zechariah

c. 520 BCE
   Zerubbabel leads the first group of Jews from captivity back to Jerusalem

516 BCE
   Second Temple consecrated

c. 475 BCE
   Often associated with Xerxes I of Persia, Queen Esther revealed her identity to the king and began to plead
   for her people, pointing to Haman as the evil schemer plotting to destroy them.

c. 460 BCE
   Seeing anarchy breaking out in Judea, Xerxes' successor Persian King Artaxerxes sent Ezra to restore order.

* The Exodus (which we know of from Jewish sources) took place in the Jewish year 2448, and the CE begins in the
  Jewish year 3760. Between 2448 and 3760 are 1312 years.

332 BCE
   Alexander the Great conquers Phoenicia and Gaza, probably passing by Judea without entering the Jewish
   dominated hill country on his way into Egypt.

200 BCE–100 CE
   At some point during this era the Tanakh (Hebrew Bible) is canonized. Jewish religious works that were
   explicitly written after the time of Ezra were not canonized, although many became popular among many
   groups of Jews. Those works that made it into the Greek translation of the Bible (the Septuagint) became
   known as the deuterocanonical books.

167–161 BCE
   The Maccabean Revolt against the Hellenistic Seleucid Empire, led by Judas Maccabeus, resulting in
   victory and installation of the Hanukkah holiday.

157–129 BCE
   Hasmonean dynasty establishes its royal dominance in Judea during renewed war with the Seleucid
   Empire.
63 BCE
Pompey lay siege to and entered the Temple, Judea became a client kingdom of Rome.

40 BCE–4 BCE
Herod the Great, appointed King of the Jews by the Roman Senate.

6 CE
Province of Roman Judea created by merging Judea proper, Samaria and Idumea.

10 CE
Hillel the Elder, considered the greatest Torah sage, dies, leading to the dominance of Shammai till 30 CE, see also Hillel and Shamai.

26–36 CE
Trial and crucifixion of Jesus by the Romans.

30 CE
Helena of Adiabene, a vassal Parthian kingdom in Mesopotamia, converts to Judaism. Significant numbers of Adiabene population follow her, later also providing limited support for Jews during Jewish-Roman wars. In the following centuries the community mostly converts to Christianity.

30–70 CE
Schism within Judaism during the Second Temple era. A sect within Hellenised Jewish society starts Jewish Christianity, see also Rejection of Jesus.

66–70
The First Jewish–Roman War ended with destruction of the Second Temple and the fall of Jerusalem. 1,100,000 people are killed by the Romans during the siege, and 97,000 captured and enslaved. The Sanhedrin was relocated to Yavne by Yochanan ben Zakai, see also Council of Jamnia. Fiscus Judaicus levied on all Jews of the Roman Empire whether they aided the revolt or not.

70–200
Period of the Tannaim, rabbis who organized and elucidated the Oral Torah. The decisions of the Tannaim are contained in the Mishnah, Beraita, Tosefta, and various Midrash compilations.

73
Final events of the First Jewish–Roman War – the fall of Masada. Christianity starts off as a Jewish sect and then develops its own texts and ideology and branches off from Judaism to become a distinct religion.

115–117
Kitos War (Revolt against Trajan) – a second Jewish-Roman War initiated in large Jewish communities of Cyprus, Cyrene (modern Libya), Aegipta (modern Egypt) and Mesopotamia (modern Syria and Iraq). It led to mutual killing of hundreds of thousands Jews, Greeks and Romans, ending with a total defeat of Jewish rebels and complete extermination of Jews in Cyprus and Cyrene by the newly installed Emperor Hadrian.

131–136
The Roman emperor Hadrian, among other provocations, renames Jerusalem "Aelia Capitolina" and prohibits circumcision. Simon bar Kokhba (Bar Kosiba) leads a large Jewish revolt against Rome in response to Hadrian's actions. In the aftermath, most Jewish population is annihilated (about 580,000 killed) and Hadrian renames the province of Judea to Syria Palaestina, and attempts to root out Judaism.

136
Rabbi Akiva is martyred.

138
With Emperor Hadrian's death, the persecution of Jews within the Roman Empire is eased and Jews are allowed to visit Jerusalem on Tisha B'Av. In the following centuries the Jewish center moves to Galilee.

200
The Mishnah, the standardization of the Jewish oral law as it stands today, is redacted by Judah haNasi in the land of Israel.

259
Nehardea in Babylonia destroyed by the Palmyrenes, which destruction caused the widespread dispersion of Jews in the region.

220–500
Period of the Amoraim, the rabbis of the Talmud.

315–337
Roman Emperor Constantine I enacts new restrictive legislation. Conversion of Christians to Judaism is outlawed, congregations for religious services are curtailed, but Jews are also allowed to enter Jerusalem on the anniversary of the Temple's destruction.

351–352
Jewish revolt against Constantius Gallus is put down. Sepphoris is razed to the ground.

358
Because of the increasing danger of Roman persecution, Hillel II creates a mathematical calendar for calculating the Jewish month. After adopting the calendar, the Sanhedrin in Tiberias is dissolved.
361–363

The last pagan Roman Emperor, Julian, allows the Jews to return to "holy Jerusalem which you have for many years longed to see rebuilt" and to rebuild the Second Temple. Shortly after, the Emperor is assassinated, and the plan is dissolved.

363

Galilee earthquake of 363

379

In India, the Hindu king Sira Primal, also known as Iru Brahman, issued what was engraved on a tablet of brass, his permission to Jews to live freely, build synagogue, own property without conditions attached and as long as the world and moon exist.

438

The Empress Eudocia removes the ban on Jews' praying at the Temple site and the heads of the Community in Galilee issue a call "to the great and mighty people of the Jews": "Know that the end of the exile of our people has come"!

450

Redaction of the Jerusalem Talmud

500–523

Yosef Dhu Nuwas, King of Himyarite Kingdom (Modern Yemen) converting to Judaism, upgrading existing Yemenese Jewish center. His kingdom falls in a war against Axum and the Christians.

550

The main redaction of Babylonian Talmud is completed under Rabbis Ravina and Ashi. To a lesser degree, the text continues to be modified for the next 200 years.

550–700

Period of the Savoraim, the sages in Persia who put the Talmud in its final form.

555–572

The Fourth Samaritan Revolt against Byzantium results in great reduction of the Samaritan community, their Israelite faith is outlawed. Neighbouring Jews, who mostly reside in Galilee, are also affected by the oppressive rule of the Byzantines.

610–628
Jews of Galilee led by Benjamin of Tiberias gain autonomy in Jerusalem after revolting against Heraclius as a joint military campaign with ally Sassanid Empire under Khosrau II and Jewish militias from Persia, but are subsequently massacred.

612

Sisebut, king of the Visigoths, forces his Jewish subjects to convert to Christianity.

7th century

The rise and domination of Islam among largely pagan Arabs in the Arabian peninsula results in the almost complete removal and conversion of the ancient Jewish communities there, and sack of Levant from the hands of Byzantines.

700–1250

Period of the Gaonim (the Gaonic era). Jews in southern Europe and Asia Minor lived under the often intolerant rule of Christian kings and clerics. Most Jews lived in the Muslim Arab realm (Andalusia, North Africa, Palestine, Iraq and Yemen). Despite sporadic periods of persecution, Jewish communal and cultural life flowered in this period. The universally recognized centers of Jewish life were in Jerusalem and Tiberias (Syria), Sura and Pumbeditha (Iraq). The heads of these law schools were the Gaonim, who were consulted on matters of law by Jews throughout the world. During this time, the Niqqud is invented in Tiberias.

711

Muslim armies invade and occupy most of Spain (At this time Jews made up about 8% of Spain's population). Under Christian rule, Jews had been subject to frequent and intense persecution, which was formalized under Muslim rule due to the dhimmi rules in Islam. Jews and Christians had to pay the jizya. Some sources mark this as the beginning of the Golden age of Jewish culture in Spain, though most mention 912.

740

The Khazar (a Turkic semi-nomadic people from Central Asia) King and members of the upper class adopt Judaism. The Khazarate lasts until 10th century, being overrun by Russians, and finally conquered by Russian and Byzantian forces in 1016.

760

The Karaites reject the authority of the oral law, and split off from rabbinic Judaism.

807

Abassid Caliph Harun al-Rashid orders all Jews in the Caliphate to wear a yellow belt, with Christians to wear a blue one.
In Sura, Iraq, Rav Amram Gaon compiles his siddur (Jewish prayer book.)

al-Mutawakkil made a decree ordering dhimmi Jews and Christians to wear garments distinguishing them from Muslims, their places of worship to be destroyed, and allowing them little involvement in government or official matters.

An incomplete marriage contract dated to October 6 of this year is the earliest dated document found in the papers of the Cairo Geniza.

The Golden age of Jewish culture in Spain. Abd-ar-Rahman III becomes Caliph of Spain in 912, ushering in the height of tolerance. Muslims granted Jews and Christians exemptions from military service, the right to their own courts of law, and a guarantee of safety of their property. Jewish poets, scholars, scientists, statesmen and philosophers flourished in and were an integral part of the extensive Arab civilization. This period ended with the Cordoba massacre in 1013.

In Iraq, Saadia Gaon compiles his siddur (Jewish prayer book).

In the Serenissima Repubblica di Venezia, the Senate forbids sea captains from accepting Jewish passengers.

Caliph Al-Hakim bi-Amr Allah ("the Mad") issues severe restrictions against Jews in the Fatimid Empire. All Jews are forced to wear a heavy wooden "golden calf" around their necks. Christians had to wear a large wooden cross and members of both groups had to wear black hats.

During the fall of the city, Sulayman's troops looted Córdoba and massacred citizens of the city, including many Jews. Prominent Jews in Córdoba, such as Samuel ibn Naghrela were forced to flee to the city in 1013.

Rabbi Yitchaki Alfassi (from Morocco, later Spain) writes the Rif, an important work of Jewish law.
The Jewish community of Kairouan, Tunisia is forced to choose between conversion and expulsion.

1033
Following their conquest of the city from the Maghrawa tribe, the forces of Tamim, chief of the Zenata Berber Banu Ifran tribe, perpetrated a massacre of Jews in Fez.

1040–1105
Rabbi Shlomo Yitzhaki (Rashi) writes important commentaries on almost the entire Tanakh and Talmud.

1066 December 30
Granada massacre: Muslim mob stormed the royal palace in Granada, crucified Jewish vizier Joseph ibn Naghrela and massacred most of the Jewish population of the city. "More than 1,500 Jewish families, numbering 4,000 persons, fell in one day."

1090
Granada was captured by Yusuf ibn Tashfin, King of the Almoravides. The Jewish community, believed to have sided with the Christians, was destroyed. Many fled, penniless, to Christian Toledo.

1095–1291
Christian Crusades begin, sparking warfare with Islam in Palestine. Crusaders temporarily capture Jerusalem in 1099. Tens of thousands of Jews are killed by European crusaders throughout Europe and in the Middle East.

1100–1275
Time of the tosafot, Talmudic commentators who carried on Rashi's work. They include some of his descendants.

1107
Moroccan Almoravid ruler Yusuf ibn Tashfin expels Moroccan Jews who do not convert to Islam.

1135–1204
Rabbi Moses ben Maimon, aka Maimonides or the Rambam is the leading rabbi of Sephardic Jewry. Among his many accomplishments, he writes one of the most influential codes of law (The Mishneh Torah) in Jewish History as well as, in Arabic, many philosophical works including the (Guide for the Perplexed).

1141
Yehuda Halevi issues a call to the Jews to emigrate to Palestine. He is buried in Jerusalem.

1148
Berbers oblige Jews to convert in Cordoba. Maimonides leaves Cordoba.
1176

Maimonides completed his Introduction to the Mishneh Torah.

1187

Upon the capture of Jerusalem, Saladin summons the Jews and permits them to resettle in the city. In particular, the residents of Ashkelon, a large Jewish settlement, respond to his request.

1189

Jacob of Orléans slain in antisemitic riots that swept through London during the coronation of King Richard I. The king later punished the perpetrators of the crime.

1190

150 Jews of York, England, killed in a pogrom, known as the York Massacre.

1240

Jews living in England, under King Henry III, were blamed for counterfeiting the money and when the local citizens began to exact revenge on them, the king expelled his Jewish subjects in order to save them from harm.

1250–1300

The life of Moses de Leon, of Spain. He publishes to the public the Zohar the 2nd century CE esoteric interpretations of the Torah by Rabbi Shimon bar Yochai and his disciples. This begins the modern form of Kabbalah (esoteric Jewish mysticism).

1250–1550

Period of the Rishonim, the medieval rabbinic sages. Most Jews at this time lived in lands bordering the Mediterranean Sea or in Western Europe under feudal systems. With the decline of Muslim and Jewish centers of power in Iraq, there was no single place in the world which was a recognized authority for deciding matters of Jewish law and practice. Consequently, the rabbis recognized the need for writing commentaries on the Torah and Talmud and for writing law codes that would allow Jews anywhere in the world to be able to continue living in the Jewish tradition.

1267

Nahmanides (Ramban) settles in Jerusalem and builds the Ramban Synagogue.

1270–1343

Rabbi Jacob ben Asher of Spain writes the Arba’ah Turim (Four Rows of Jewish Law).

1276

Massacre in Fez to kill all Jews stopped by intervention of the Emir.
1290
Jews are expelled from England by Edward I after the banning of usury in the 1275 Statute of Jewry.

1300
Rabbi Levi ben Gershon, aka Gersonides. A 14th-century French Jewish philosopher best known for his Sefer Milhamot Adonai ("The Book of the Wars of the Lord") as well as for his philosophical commentaries.

1304–1394
Jews are repeatedly expelled from France and readmitted, for a price.

1343
Jews persecuted in Western Europe are invited to Poland by Casimir the Great.

1346–1353
Jews scapegoated as the cause of the growing Black Death. See also Medieval antisemitism

1348
Pope Clement VI issued two papal bulls in 1348 (6 July and 26 September), the latter named Quamvis Perfidiam, which condemned the violence and said those who blamed the plague on the Jews had been "seduced by that liar, the Devil." He urged clergy to take action to protect Jews as he had done.

1349
The Strasbourg massacre

1350s
Genetic testing conducted on Ashkenazi Jews have pointed to a bottleneck that was created in the 1300s amongst the Jewish population where it dwindled down to as few as 250–420 people.

1369–70
Civil war in Spain, between brothers Peter of Castile (Pedro) and Henry II of Castile (Enrico), leads to the deaths of 38,000 Jews, embroiled in the conflict.

1478
King Ferdinand and Queen Isabella of Spain institute the Spanish Inquisition.

1486
First Jewish prayer book published in Italy.

1488–1575
Rabbi Yosef Karo spends 20 years compiling the Beit Yosef, an enormous guide to Jewish law. He then writes a more concise guide, the Shulkhan Arukh, that becomes the standard law guide for the next 400 years. Born in Spain, Yosef Karo lives and dies in Safed.

1488
Obadiah ben Abraham, commentator on the Mishnah, arrives in Jerusalem and marks a new epoch for the Jewish community.

1492
The Alhambra Decree: Approximately 200,000 Jews are expelled from Spain, The expelled Jews relocate to the Netherlands, Turkey, Arab lands, and Judea; some eventually go to South and Central America. However, most emigrate to Poland. In later centuries, more than 50% of Jewish world population lived in Poland. Many Jews remain in Spain after publicly converting to Christianity, becoming Crypto-Jews.

1492
Bayezid II of the Ottoman Empire issued a formal invitation to the Jews expelled from Spain and Portugal and sent out ships to safely bring Jews to his empire.

1493
Jews expelled from Sicily. As many as 137,000 exiled.

1496
Jews expelled from Portugal and from many German cities.

1501
King Alexander of Poland readmits Jews to Grand Duchy of Lithuania.

1511
Printing of Jewish books by mechanical press began by Daniel Bomberg.

1516
Ghetto of Venice established, the first Jewish ghetto in Europe. Many others follow.

1525–1572
Rabbi Moshe Isserles (The Rema) of Kraków writes an extensive commentary to the Shulkhan Arukh called the Mappah, extending its application to Ashkenazi Jewry.

1534
King Sigismund I of Poland abolishes the law that required Jews to wear special clothes.
First Yiddish book published, in Poland.

1534–1572
Isaac Luria ("the Arizal") teaches Kabbalah in Jerusalem and (mainly) Safed to select disciples. Some of those, such as Ibn Tebul, Israel Sarug and mostly Chaim Vital, put his teachings into writing. While the Sarugian versions are published shortly afterwards in Italy and Holland, the Vitalian texts remain in manuscripti for as long as three centuries.

1547
First Hebrew Jewish printing house in Lublin.

1550
Jews expelled from Genoa, Italy.

1550
Moses ben Jacob Cordovero founds a Kabbalah academy in Safed.

1567
First Jewish university Jeshiva was founded in Poland.

1577
A Hebrew printing press is established in Safed, the first press in Palestine and the first in Asia.

1580–1764
First session of the Council of Four Lands (Va'ad Arba' Aratzot) in Lublin, Poland. 70 delegates from local Jewish kehillot meet to discuss taxation and other issues important to the Jewish community.

1621–1630
Shelah HaKadosh writes his most famous work after emigrating to the Land of Israel.

1623
First time separate (Va'ad) Jewish Sejm for Grand Duchy of Lithuania.

1626–1676
False Messiah Sabbatai Zevi.

1627
Kingdom of Beta Israel in what is now modern day Ethiopia collapses and loses autonomy.

1633
Jews of Poznań granted a privilege of forbidding Christians to enter into their city.
1648
Jewish population of Poland reached 450,000 (i.e., 4% of the 1,1000,000 population of Polish–Lithuanian Commonwealth is Jewish), Bohemia 40,000 and Moravia 25,000. Worldwide population of Jewry is estimated at 750,000.

1648–1655
The Ukrainian Cossack Bohdan Chmielnicki leads a massacre of Polish gentry and Jewry that leaves an estimated 65,000 Jews dead and a similar number of gentry. The total decrease in the number of Jews is estimated at 100,000.

1655
Jews readmitted to England by Oliver Cromwell.

1660
1660 destruction of Safed.

1679
Jews of Yemen expelled to Mawza

1700–1760
Israel ben Eliezer, known as the Baal Shem Tov, founds Hasidic Judaism, a way to approach God through meditation and fervent joy. He and his disciples attract many followers, and establish numerous Hasidic sects. The European Jewish opponents of Hasidim (known as Misnagdim) argue that one should follow a more scholarly approach to Judaism. Some of the more well-known Hasidic sects today include Bobover, Breslover, Gerer, Lubavitch (Chabad) and Satmar Hasidim.

1700
Rabbi Judah HeHasid makes aliyah to Palestine accompanied by hundreds of his followers. A few days after his arrival, Rabbi Yehuda dies suddenly.

1700
Sir Solomon de Medina is knighted by William III, making him the first Jew in England to receive that honour.

1720
Unpaid Arab creditors burn the synagogue unfinished by immigrants of Rabbi Yehuda and expel all Ashkenazi Jews from Jerusalem. See also Hurva Synagogue

1720–1797
Rabbi Elijah of Vilna, the Vilna Gaon.
Moses Mendelssohn and the Haskalah (Enlightenment) movement. He strove to bring an end to the isolation of the Jews so that they would be able to embrace the culture of the Western world, and in turn be embraced by gentiles as equals. The Haskalah opened the door for the development of all the modern Jewish denominations and the revival of Hebrew as a spoken language, but it also paved the way for many who, wishing to be fully accepted into Christian society, converted to Christianity or chose to assimilate to emulate it.

Parliament of Great Britain passes a general act permitting Jews to be naturalized in the American colonies. Previously, several colonies had also permitted Jews to be naturalized without taking the standard oath "upon the true faith of a Christian."

Ottoman authorities invite Rabbi Haim Abulafia (1660–1744), renowned Kabbalist and Rabbi of Izmir, to come to the Holy Land. Rabbi Abulafia is to rebuild the city of Tiberias, which has lain desolate for some 70 years. The city's revival is seen by many as a sign of the coming of the Messiah.

Thousands immigrate to Palestine under the influence of Messianic predictions. The large immigration greatly increases the size and strength of the Jewish Settlement in Palestine.

Rabbi Abraham Gershon of Kitov (Kuty) (1701–1761) is the first immigrant of the Hasidic Aliyah. He is a respected Talmudic scholar, mystic, and brother-in-law of Rabbi Israel Baal Shem Tov (founder of the Hasidic movement). Rabbi Abraham first settles in Hebron. Later, he relocates to Jerusalem at the behest of its residents.

Followers of Jacob Frank joined ranks of Polish szlachta (gentry) of Jewish origins.

Partitions of Poland between Russia, Kingdom of Prussia and Austria. Main bulk of World Jewry lives now in those 3 countries. Old privileges of Jewish communities are denounced.

American Revolution; guaranteed the freedom of religion.

Mob violence against the Jews of Hebron.
1789
The French Revolution. In 1791 France grants full right to Jews and allows them to become citizens, under certain conditions.

1790
In the US, President George Washington sends a letter to the Jewish community in Rhode Island. He writes that he envisions a country "which gives bigotry no sanction...persecution no assistance". Despite the fact that the US was a predominantly Protestant country, theoretically Jews are given full rights. In addition, the mentality of Jewish immigrants shaped by their role as merchants in Eastern Europe meant they were well-prepared to compete in American society.

1791
Russia creates the Pale of Settlement that includes land acquired from Poland with a huge Jewish population and in the same year Crimea. The Jewish population of the Pale was 750,000. 450,000 Jews lived in the Prussian and Austrian parts of Poland.

1798
Rabbi Nachman of Breslov travels to Palestine.

1799
While French troops were in Palestine besieging the city of Acre, Napoleon prepared a Proclamation requesting Asian and African Jews to help him conquer Jerusalem, but his unsuccessful attempt to capture Acre prevented it from being issued.

1799
Mob violence on Jews in Safed.

1800–1900
The Golden Age of Yiddish literature, the revival of Hebrew as a spoken language, and the revival of Hebrew literature.

1808–1840
Large-scale aliyah in hope of Hastening Redemption in anticipation of the arrival of the Messiah in 1840.

1820–1860
The development of Orthodox Judaism, a set of traditionalist movements that resisted the influences of modernization that arose in response to the European emancipation and Enlightenment movements; characterized by continued strict adherence to Halakha.
Greece grants citizenship to Jews.

1831
Jewish militias take part in the defense of Warsaw against Russians.

1834–1835
Muslims, Druze attack Jews in Safed, Hebron & in Jerusalem.

1837
Moses Haim Montefiore is knighted by Queen Victoria

1837
Galilee earthquake of 1837 devastates Jewish communities of Safed and Tiberias.

1838–1933
Rabbi Yisroel Meir ha-Kohen (Chofetz Chaim) opens an important yeshiva. He writes an authoritative Halakhic work, Mishnah Berurah.

Mid-19th century
Beginning of the rise of classical Reform Judaism.

Mid-19th century
Rabbi Israel Salanter develops the Mussar Movement. While teaching that Jewish law is binding, he dismisses current philosophical debate and advocates the ethical teachings as the essence of Judaism.

Mid-19th century
Positive-Historical Judaism, later known as Conservative Judaism, is developed.

1841
David Levy Yulee of Florida is elected to the United States Senate, becoming the first Jew elected to Congress.

1851
Norway allows Jews to enter the country. They are not emancipated until 1891.

1858
Jews emancipated in England.

1860
Alliance Israelite Universelle, an international Jewish organization is founded in Paris with the goal to protect Jewish rights as citizens.
1860–1875
Moshe Montefiori builds Jewish neighbourhoods outside the Old City of Jerusalem starting with Mishkenot Sha'ananim.

1860–1864
Jews are taking part in Polish national movement, that was followed by January rising.

1860–1943
Henrietta Szold: educator, author, social worker and founder of Hadassah.

1861
The Zion Society is formed in Frankfurt am Main, Germany.

1862
Jews are given equal rights in Russian-controlled Congress Poland. The privileges of some towns regarding prohibition of Jewish settlement are revoked. In Leipzig, Moses Hess publishes the book Rome and Jerusalem, the first book to call for the establishment of a Jewish socialist commonwealth in Palestine. The book is also notable for giving the impetus for the Labor Zionist movement.

1867
Jews emancipated in Hungary.

1868
Benjamin Disraeli becomes Prime Minister of the United Kingdom. Though converted to Christianity as a child, he is the first person of Jewish descent to become a leader of government in Europe.

1870–1890
Russian Zionist group Hovevei Zion (Lovers of Zion) and Bilu (est. 1882) set up a series of Jewish settlements in the Land of Israel, financially aided by Baron Edmond James de Rothschild. In Rishon LeZion Eliezer ben Yehuda revives Hebrew as spoken modern language.

1870
Jews emancipated in Italy.

1871
Jews emancipated in Germany.

1875
Reform Judaism's Hebrew Union College is founded in Cincinnati. Its founder was Rabbi Isaac Mayer Wise, the architect of American Reform Judaism.
1877
New Hampshire becomes the last state to give Jews equal political rights.

1878
Petah Tikva is founded by religious pioneers from Jerusalem, led by Yehoshua Stampfer.

1880
World Jewish population around 7.7 million, 90% in Europe, mostly Eastern Europe; around 3.5 million in the former Polish provinces.

1881–1884, 1903–1906, 1918–1920
Three major waves of pogroms kill tens of thousands of Jews in Russia and Ukraine. More than two million Russian Jews emigrate in the period 1881–1920.

1881
On December 30–31, the First Congress of all Zionist Unions for the colonization of Palestine was held at Focșani, Romania.

1882–1903
The First Aliyah, a major wave of Jewish immigrants to build a homeland in Palestine.

1886
Rabbi Sabato Morais and Alexander Kohut begin to champion the Conservative Jewish reaction to American Reform, and establish The Jewish Theological Seminary of America as a school of 'enlightened Orthodoxy'.

1890
The term "Zionism" is coined by an Austrian Jewish publicist Nathan Birnbaum in his journal Self Emancipation and was defined as the national movement for the return of the Jewish people to their homeland and the resumption of Jewish sovereignty in the Land of Israel.

1895
First published book by Sigmund Freud.

1897
In response to the Dreyfus affair, Theodore Herzl writes Der Judenstaat (The Jewish State), advocating the creation of a free and independent Jewish state in Israel.

1897
The Bund (General Jewish Labour Bund) is formed in Russia.
1897
First Russian Empire Census: 5,200,000 of Jews, 4,900,000 in the Pale. The lands of former Poland [clarification needed] have 1,300,000 Jews or 14% of population.

1897
The First Zionist Congress was held at Basel, which brought the World Zionist Organization (WZO) into being.

1902
Rabbi Dr. Solomon Schechter reorganizes the Jewish Theological Seminary of America and makes it into the flagship institution of Conservative Judaism.

1903

1905
1905 Russian Revolution accompanied by pogroms.

1915
Yeshiva College (later University) and its Rabbi Isaac Elchanan Rabbinical Seminary is established in New York City for training in a Modern Orthodox milieu.

1916
Louis Brandeis, on the first of June, is confirmed as the United States' first Jewish Supreme Court justice. Brandeis was nominated by American President Woodrow Wilson.

1917
The British defeat the Turks and gain control of Palestine. The British issue the Balfour Declaration which gives official British support for "the establishment in Palestine of a national home for the Jewish people ... it being clearly understood that nothing shall be done which may prejudice the civil and religious rights of existing non-Jewish communities in Palestine". Many Jews interpret this to mean that all of Palestine was to become a Jewish state.

1917 February
The Pale of Settlement is abolished, and Jews get equal rights. The Russian civil war leads to over 2,000 pogroms with tens of thousands murdered and hundreds of thousand made homeless.

1918–1939
The period between the two World Wars is often referred to as the "golden age" of hazzanut (cantors). Some of the great Jewish cantors of this era include Abraham Davis, Moshe Koussevitzky, Zavel Kwartin (1874–1953), Jan Peerce, Josef "Yossele" Rosenblatt (1882–1933), Gershon Sirota (1874–1943), and Laibale Waldman.

1919

February 15: Over 1,200 Jews killed in Khmelnitsky pogrom.

March 25: Around 4,000 Jews killed by Cossack troops in Tetiev.

June 17: 800 Jews decapitated in assembly-line fashion in Dubova [uk].

1920

At the San Remo conference Britain receives the League of Nations' British Mandate of Palestine.

April 4–7: Five Jews killed and 216 wounded in the Jerusalem riots

1920s–present

A variety of Jewish authors, including Gertrude Stein, Allen Ginsberg, Saul Bellow, Adrienne Rich and Philip Roth, sometimes drawing on Jewish culture and history, flourish and become highly influential on the Anglophone literary scene.

1921

British military administration of the Mandate is replaced by civilian rule.

1921

Britain proclaims that all of Palestine east of the Jordan River is forever closed to Jewish settlement, but not to Arab settlement.

1921

Polish–Soviet peace treaty in Riga. Citizens of both sides are given rights to choose the country. Hundred thousands of Jews, especially small businesses forbidden in the Soviets, move to Poland.

1922

Reform Rabbi Stephen S. Wise established the Jewish Institute of Religion in New York. (It merged with Hebrew Union College in 1950.)

1923

Britain gives the Golan Heights to the French Mandate of Syria. Arab immigration is allowed; Jewish immigration is not.
The First World Congress of Jewish Women is held 6–11 May in Vienna.

1924
2,989,000 Jews according to religion poll in Poland (10.5% of total). Jewish youth consisted 23% of students of high schools and 26% of students of universities.

1926
Prior to World War I, there were few Hasidic yeshivas in Europe. On Lag BaOmer 1926, Rabbi Shlomo Chanoch Hacohen Rabinowicz, the fourth Radomsker Rebbe, declared, "The time has come to found yeshivas where the younger generation will be able to learn and toil in Torah", leading to the founding of the Keser Torah network of 36 yeshivas in pre-war Poland.

1929
A long-running dispute between Muslims and Jews over access to the Western Wall in Jerusalem escalates into the 1929 Palestine riots. The riots took the form in the most part of attacks by Arabs on Jews resulting in the 1929 Hebron massacre, the 1929 Safed pogrom and violence against Jews in Jerusalem.

1930
World Jewry: 15,000,000. Main countries USA (4,000,000), Poland (3,500,000 11% of total), Soviet Union (2,700,000 2% of total), Romania (1,000,000 6% of total). Palestine 175,000 or 17% of total 1,036,000.

1933
Hitler takes over Germany; his anti-Semitic sentiments are well-known, prompting numerous Jews to emigrate.

1935
Regina Jonas became the first woman to be ordained as a rabbi.

1937
Adin Steinsaltz born, author of the first comprehensive Babylonian Talmud commentary since Rashi in the 11th century.

1939
The British government issues the 'White Paper'. The paper proposed a limit of 10,000 Jewish immigrants for each year between 1940–1944, plus 25,000 refugees for any emergency arising during that period.

1938–1945
The Holocaust (Ha Shoah), resulting in the methodical extermination of nearly 6 million Jews across Europe.
1940s–present
Various Jewish filmmakers, including Billy Wilder, Woody Allen, Mel Brooks and the Coen Brothers, frequently draw on Jewish philosophy and humor, and become some of the most artistically and popularly successful in the history of the medium.

1941
The Muslim residents of Baghdad carried out a savage pogrom against their Jewish compatriots. In this pogrom, known by its Arabic name al-Farhud, about 200 Jews were murdered and thousands wounded, on June 1–2. Jewish property was plundered and many homes set ablaze.

1945–1948

1946–1948
The violent struggle for the creation of a Jewish state in the British mandate of Palestine is intensified by Jewish defense groups: Haganah, Irgun, and Lehi (group).

November 29, 1947
The United Nations approves the creation of a Jewish State and an Arab State in the British mandate of Palestine.

May 14, 1948
The State of Israel declares itself as an independent Jewish state hours before the British Mandate is due to expire. Within eleven minutes, it is de facto recognized by the United States. Andrei Gromyko, the Soviet Union's UN ambassador, calls for the UN to accept Israel as a member state. The UN approves.

May 15, 1948
1948 Arab–Israeli War: Syria, Iraq, Transjordan, Lebanon and Egypt invade Israel hours after its creation. The attack is repulsed, and Israel conquers more territory. A Jewish exodus from Arab and Muslim lands results, as up to a million Jews flee or are expelled from Arab and Muslim nations. Most settle in Israel. See also 1949 Armistice Agreements.

1948–1949
Almost 250,000 Holocaust survivors make their way to Israel. "Operation Magic Carpet" brings thousands of Yemenite Jews to Israel.

1956
The 1956 Suez War Egypt blockades the Gulf of Aqaba, and closes the Suez canal to Israeli shipping. Egypt's President Nasser calls for the destruction of Israel. Israel, England, and France go to war and force Egypt to end the blockade of Aqaba, and open the canal to all nations.
1964
Jewish-Christian relations are revolutionized by the Roman Catholic Church's Vatican II.

1966
Shmuel Yosef Agnon (1888–1970) becomes the first Hebrew writer to win the Nobel Prize in literature.

May 16, 1967
Egyptian President Nasser demands that the UN dismantle the UN Emergency Force I (UNEF I) between Israel and Egypt. The UN complies and the last UN peacekeeper is out of Sinai and Gaza by May 19.

1967 May
Egyptian President Gamal Abdel Nasser closes the strategic Straits of Tiran to Israeli shipping and states that Egypt is in a state of war with Israel. Egyptian troops begin massing in the Sinai.

June 5–10, 1967
The Six-Day War. Israel launches a pre-emptive strike against Egypt, Jordan, and Syria. Israeli aircraft destroy the bulk of the Arab air forces on the ground in a surprise attack, followed by Israeli ground offensives which see Israel decisively defeat the Arab forces and capture the Sinai Peninsula, the West Bank, and the Golan Heights.

September 1, 1967
The Arab Leaders meet in Khartoum, Sudan. The Three No's of Khartoum: No recognition of Israel. No negotiations with Israel. No peace with Israel.

1968
Rabbi Mordechai Kaplan formally creates a separate Reconstructionist Judaism movement by setting up the Reconstructionist Rabbinical College in Philadelphia.

1969
First group of African Hebrew Israelites begin to migrate to Israel under the leadership of Ben Ammi Ben Israel.

Mid-1970s to present
Growing revival of Klezmer music (The folk music of European Jews).

1972
Sally Priesand became the first female rabbi ordained in America, and is believed to be only the second woman ever to be formally ordained in the history of Judaism.

1972
Mark Spitz sets the record for most gold medals won in a single Olympic Games (seven) in the 1972 Summer Olympics. The Munich massacre occurs when Israeli athletes are taken hostage by Black September terrorists. The hostages are killed during a failed rescue attempt.

October 6–24, 1973

The Yom Kippur War. Egypt and Syria, backed up by expeditionary forces from other Arab nations, launch a surprise attack against Israel on Yom Kippur. After absorbing the initial attacks, Israel recaptures lost ground and then pushes into Egypt and Syria. Subsequently, OPEC reduces oil production, driving up oil prices and triggering a global economic crisis.

1975

President Gerald Ford signs legislation including the Jackson-Vanik amendment, which ties U.S. trade benefits to the Soviet Union to freedom of emigration for Jews.

1975


1976

Israel rescues hostages taken to Entebbe, Uganda.

September 18, 1978

At Camp David, near Washington D.C., Israel and Egypt sign a comprehensive peace treaty, The Camp David Accord, which included the withdrawal of Israel from the Sinai.

1978

Yiddish writer Isaac Bashevis Singer receives Nobel Prize

1979

Prime Minister Menachem Begin and President Anwar Sadat are awarded Nobel Peace Prize.

1979–1983

Operation Elijah: Rescue of Ethiopian Jewry.

1982 June–December

The Lebanon War. Israel invades Southern Lebanon to drive out the PLO.

1983

American Reform Jews formally accept patrilineal descent, creating a new definition of who is a Jew.

1984–1985

Operations Moses, Joshua: Rescue of Ethiopian Jewry by Israel.
1986

Elie Wiesel wins the Nobel Peace Prize

1986

Nathan Sharansky, Soviet Jewish dissident, is freed from prison.

1987

Beginning of the First Intifada against Israel.

1989

Fall of the Berlin Wall between East and West Germany, collapse of the communist East German government, and the beginning of Germany's reunification (which formally began in October 1990).

1990

The Soviet Union opens its borders for the three million Soviet Jews who had been held as virtual prisoners within their own country. Hundreds of thousands of Soviet Jews choose to leave the Soviet Union and move to Israel.

1990–1991

Iraq invades Kuwait, triggering a war between Iraq and Allied United Nations forces. Israel is hit by 39 Scud missiles from Iraq.

1991

Operation Solomon: Rescue of the remainder of Ethiopian Jewry in a twenty-four-hour airlift.

October 30, 1991

The Madrid Peace Conference opens in Spain, sponsored by the United States and the Soviet Union.

April 22, 1993

The United States Holocaust Memorial Museum dedicated.

September 13, 1993

Israel and PLO sign the Oslo Accords.

1994

The Lubavitcher (Chabad) Rebbe, Menachem Mendel Schneerson, dies.

October 26, 1994

Israel and Jordan sign an official peace treaty. Israel cedes a small amount of contested land to Jordan, and the countries open official diplomatic relations, with open borders and free trade.
December 10, 1994
Arafat, Rabin and Israeli Foreign Minister Shimon Peres share the Nobel Peace Prize.

November 4, 1995
Israeli Prime Minister Yitzhak Rabin is assassinated.

1996
Peres loses election to Benyamin (Bibi) Netanyahu (Likud party).

1999
Ehud Barak elected Prime Minister of Israel.

May 24, 2000
Israel unilaterally withdraws its remaining forces from its security zone in southern Lebanon to the international border, fully complying with the UN Security Council Res. 425.

2000 July
Camp David Summit.

2000, Summer
Senator Joseph Lieberman becomes the first Jewish-American to be nominated for a national office (Vice President of the United States) by a major political party (the Democratic Party).

September 29, 2000
The al-Aqsa Intifada begins.

2001
Election of Ariel Sharon as Israel's Prime Minister.

2001
Jewish Museum of Turkey is founded by Turkish Jewry

2004
Avram Hershko and Aaron Ciechanover of the Technion win the Nobel Prize in Chemistry. The Jewish Autonomous Oblast builds its first synagogue, Birobidzhan Synagogue, in accordance with halakha. Uriyahu Butler became the first member of the African Hebrew Israelite community to enlist in the Israel Defense Forces (IDF)

March 31, 2005
The Government of Israel officially recognizes the Bnei Menashe people of North-East India as one of the Ten Lost Tribes of Israel, opening the door for thousands of people to immigrate to Israel.
2005 August
The Government of Israel withdraws its military forces and settlers from the Gaza Strip.

2005 December
Prime Minister Ariel Sharon falls into a coma; Deputy Premier Ehud Olmert takes over as Acting Prime Minister.

2006 March
Ehud Olmert leads the Kadima party to victory in Israeli elections, becomes Prime Minister of Israel.

2006 July–August
A military conflict in Lebanon and northern Israel started on July 12, after a Hezbollah cross-border raid into Israel. The war ended with the passage of United Nations Security Council Resolution 1701 after 34 days of fighting. About 2,000 Lebanese and 159 Israelis were killed, and civilian infrastructure on both sides heavily damaged.

2008 December
The Israel Defense Forces (IDF) launches Operation Cast Lead (מבצע מבצע מבצע) against Hamas in the Gaza Strip.

2009 March
Benjamin Netanyahu becomes Prime Minister of Israel (also, continues as the Chairman of the Likud Party).

2014 January
Ariel Sharon dies, after undergoing a sudden decline in health, having suffered renal failure and other complications, after spending 8 years in a deep coma due to his January 2006 stroke, on January 11, 2014.

2016 March
The Jewish Agency declares an end to immigration from Yemen, following the successful conclusion of a covert operation that brought 19 people to Israel over several days. The last 50 Yemenite Jews refuse to leave Yemen.

2017 December
President Donald Trump announces formal United States recognition of Jerusalem as the capital of Israel.

2019 March
The United States became the first country to recognize Israeli sovereignty over the Golan heights territory which it held since 1967.
Timeline of Zionism

Early modern period

1561
Joseph Nasi encourages Jewish settlement in Tiberias, having fled the Spanish Inquisition fourteen years previously in 1547.

1615
Thomas Brightman's Shall they return to Jerusalem again? is published posthumously.

1621
Sir Henry Finch publishes The World's Great Restauration, or Calling of the Jews, and with them of all Nations and Kingdoms of the Earth to the Faith of Christ.

1649
Ebenezer and Joanna Cartwright dispatch a petition to the British Government calling for the ban on Jews settling in England to be lifted and for assistance to be provided to enable them to be repatriated to Palestine.

1670
Baruch Spinoza's Theologico-Political Treatise is the first work to consider the Jewish Question in Europe.

1700
Judah he-Hasid leads some 1,500 Jewish immigrants to the Land of Israel and settles in Jerusalem. Three days after the group's arrival their leader dies (on October 17, 1700). In 1720 their synagogue was burned down and all Ashkenazi Jews were banned by the Ottomans.

1771
Joseph Eyre publishes a scholarly essay entitled Observations Upon The Prophecies Relating To The Restoration Of The Jews.

1777
Menachem Mendel of Vitebsk along with a large group of followers emigrates and settles in Safed. In 1783 they were forced out of Safed, and moved to Tiberias.

1794
Richard Brothers, a millenarianist, Christian restorationist, a false prophet and the founder of British Israelism, writes *A revealed knowledge of the prophecies & times*, predicting the return of the Jews to Jerusalem in 1798 where they will be converted to Christianity.

1805

Foundation of the Palestine Association, stating amongst other goals that "we hope to establish relative to the history, the manners, and the country of the Jewish nation"

1808

The first group of Perushim, influenced by the teachings of the Vilna Gaon, leaves Shklov and after a 15-month journey settles in Jerusalem and Safed.

1809

Foundation of the London Society for Promoting Christianity amongst the Jews

1811

François-René de Chateaubriand, the founder of Romanticism in French literature, published *Itinéraire de Paris à Jérusalem*, in which he wrote of the Jews of Jerusalem as "rightful masters of Judea living as slaves and strangers in their own country"

1815

English poet Lord Byron publishes his Hebrew Melodies. The poem does not refer to a return to Palestine, but is one of the first literary works of Jewish nationalism.

1819

Wissenschaft des Judentums ("Jewish Studies") began to build a secular Jewish identity in the German Confederation

1827

John Nelson Darby's Plymouth Brethren is founded to propagate the Christian eschatological movement of dispensationalism, which teaches that God looks upon Jews as the chosen people (rejecting supersessionism), and that the nation of Israel will be born again and brought to realize they crucified their Messiah at his second coming

1821–30

The Greek War of Independence legitimized the concept of small ethnically-based nation-states among other subject peoples of the Ottoman Empire
After the Egyptian-Ottoman War

1833

Benjamin Disraeli, then 28 years old, writes The Wondrous Tale of Alroy about David Alroy's messianic mission to Jerusalem.

1837

Lord Lindsay travels to Palestine. In 1838 he wrote Letters on Egypt, Edom and the Holy Land in which he stated "Many I believe entertain the idea that an actual curse rests on the soil of Palestine, and may be startled therefore at the testimony I have borne to its actual richness. Let me not be misunderstood: richly as the valleys wave with corn, and beautiful as is the general aspect of modern Palestine, vestiges of the ancient cultivation are everywhere visible... proofs far more than sufficient that the land still enjoys her Sabbaths, and only waits the return of her banished children, and the application of industry commensurate with her agricultural capabilities, to burst once more into universal luxuriance—all that she ever was in the days of Solomon."

1839

The General Assembly of the Church of Scotland passes an Act on the Conversion of the Jews, and sends four Church of Scotland ministers, Andrew Bonar, Robert Murray M’Cheyne, Alexander Keith and Alexander Black to Palestine. They publish the popular book Narrative of a Visit to the Holy Land; And, Mission of Inquiry to the Jews in 1842.

1839

Judah Alkalai publishes his pamphlet Darhei No'am (The Pleasant Paths) advocating the restoration of the Jews in the Land of Israel as a precursor to the coming of the Messiah, followed in 1840 by Shalom Yerushalayim (The Peace of Jerusalem).

1839

Lord Shaftesbury takes out a full-page advert in The Times addressed to the Protestant monarchs of Europe and entitled "The State and the rebirth of the Jews", which included the suggestion for the Jews to return to Palestine to seize the lands of Galilee and Judea, as well as the phrase "Earth without people—people without land."

1840

Lord Shaftesbury presents a paper to British Foreign Minister Lord Palmerston calling for the 'recall of the Jews to their ancient land'.

1840 (August 11)
Lord Palmerston writes to Lord Ponsonby, British Ambassador to the Ottoman Empire: “There exists at the present time among the Jews dispersed over Europe, a strong notion that the time is approaching when their nation is to return to Palestine... It would be of manifest importance to the Sultan to encourage the Jews to return and settle in Palestine because the wealth which they would bring with them would increase the resources of the Sultan's dominions; and the Jewish people, if returning under the sanction and protection, and at the invitation of the Sultan, would be a check upon any future evil designs of Mehemet Ali (of Egypt) or his successor... I have to instruct Your Excellency strongly to re-commend (to the Turkish Government) to hold out every just encouragement to the Jews of Europe to return to Palestine.”

1841

George Gawler, previously the governor of South Australia, starts to encourage Jewish settlements in the land of Israel.

1842

Nadir Baxter, of the Church Pastoral Aid Society, died in 1842 and donated £1,000 in his will, stating that it be paid "towards the political restoration of the Jews to Jerusalem and to their own land; and as I conscientiously believe also that the institution by the Anglican Church of the bishopric of Jerusalem is the actual commencement of the great and merciful work of Jehovah towards Zion". The gift was declared void in 1851 in the case of Habershon v Vardon by Sir James Lewis Knight-Bruce, Chancellor of the High Court, who stated "If it can be understood to mean any thing, it is to create a revolution in the dominions of an ally of her Majesty".

1841–42

Correspondence between Moses Montefiore, the President of the Board of Deputies of British Jews and Charles Henry Churchill, the British consul in Damascus, is seen as the first recorded plan proposed for political Zionism.

1844

Mordecai Noah publishes Discourse on the Restoration of the Jews.

1844

According to one source, the Old Yishuv Jews constitute the largest of several ethno-religious groups in Jerusalem – however estimates approximately 20 years before and 20 years after this date suggest otherwise. See Demographics of Jerusalem.

1844

Rev. Samuel Bradshaw, in his Tract for the Times, Being a Plea for the Jews calls for Parliament to allot 4 million pounds for the Restoration of Israel, with another 1 million to be collected by the Church.
Pastor T. Tully Crybace convenes a committee in London for the purpose of founding a 'British and Foreign Society for Promoting the Restoration of the Jewish Nation to Palestine.' He urges that England secure from Turkey Palestine 'from the Euphrates to the Nile, and from the Mediterranean to the Desert'.

1845

George Gawler publishes "Tranquilization of Syria and the East: Observations and Practical Suggestions, in Furtherance of the Establishment of Jewish Colonies in Palestine, the Most Sober and Sensible Remedy for the Miseries of Asiatic Turkey."

1849

George Gawler accompanies Sir Moses Montefiori on a trip to Palestine, persuading him to invest in and initiate Jewish settlements in the country.

c.1850

James Finn and his wife found the "British Society for the Promotion of Jewish Agricultural Labour in the Holy Land"

1851

Correspondence between Lord Stanley, whose father became British Prime Minister the following year, and Benjamin Disraeli, who became Chancellor of the Exchequer alongside him, records Disraeli's proto-Zionist views: "He then unfolded a plan of restoring the nation to Palestine – said the country was admirably suited for them – the financiers all over Europe might help – the Porte is weak – the Turks/holders of property could be bought out – this, he said, was the object of his life...."Coningsby was merely a feeler – my views were not fully developed at that time – since then all I have written has been for one purpose. The man who should restore the Hebrew race to their country would be the Messiah – the real saviour of prophecy!" He did not add formally that he aspired to play this part, but it was evidently implied. He thought very highly of the capabilities of the country, and hinted that his chief object in acquiring power here would be to promote the return".

1852

George Gawler founds the Association for Promoting Jewish Settlement in Palestine

1853–75

Heinrich Graetz publishes History of the Jews (Geschichte der Juden), the first academic work portraying the Jews as a historical nation. Graetz's work became more nationalistic as the volumes progressed, culminating with Volumes I and II in 1873–75 after he had returned from a trip to Palestine.

1853

Abraham Mapu publishes Ahabat Zion, the first Hebrew novel, a romance of the time of King Hezekiah and Isaiah
1857
James Finn, the second British Consul in Jerusalem, writes to Foreign Secretary the Earl of Clarendon regarding his proposal "to persuade Jews in a large body to settle here as agriculturalists on the soil ... in partnership with the Arab peasantry"

1860
The Alliance Israélite Universelle is founded in Paris

1861
The Zion Society is formed in Frankfurt, Germany.

1861
Mishkenot Sha'ananim — first neighborhood of the New Yishuv outside the Old City of Jerusalem, built by Sir Moses Montefiore.

1862
Moses Hess writes Rome and Jerusalem. The Last National Question (text) arguing for the Jews to return to the Land of Israel, and proposes a socialist country in which the Jews would become agrarianised through a process of "redemption of the soil". His ideas later evolved into the Labor Zionism movement.

1862
Zvi Hirsch Kalischer publishes Derishat Zion, maintains that the salvation of the Jews, promised by the Prophets, can come about only by self-help. His ideas contributed to the Religious Zionism movement.

1867
Mark Twain visits Palestine as part of a tour of what westerners call the Holy Land.

1869
Twain publishes The Innocents Abroad, or The New Pilgrims' Progress documenting his observations through his travels. He indicated he observed that Palestine was primarily an uninhabited desert. His account was widely circulated and remains a controversial snap-shot of the area in the late 19th century.

1870
Mikveh Israel, the first modern Jewish agricultural school and settlement was established in the Land of Israel by Charles Netter of the Alliance Israélite Universelle.

1870–1890
The group Hovevei Zion (Lovers of Zion) sets up 30 Jewish farming communities in the Land of Israel.
The English novelist George Eliot publishes the widely read novel Daniel Deronda, later cited by Henrietta Szold, Eliezer Ben-Yehuda, and Emma Lazarus as having been highly influential in their decision to become Zionists.

1878 (June)

A German-language memorandum addressed to Disraeli and Bismarck is submitted to the Congress of Berlin by an anonymous Jewish group advocating the establishment of a Jewish constitutional monarchy in Palestine. It was originally thought to have been written by Disraeli himself, but later thought to be by Judah Leib Gordon. The memorandum was not discussed at the Congress, although Bismarck called it "a crazy idea".

1878

Galician poet Naphtali Herz Imber writes a poem Tikvatenu (Our Hope), later adopted as the Zionist hymn Hatikvah.

1878

Petah Tikva is founded by Jerusalem Jews, but abandoned after difficulties. Resettled in 1882 with help from first aliyah.

1878

The first Hovevei Zion ("Lovers of Zion") groups were founded in Eastern Europe

1880

Laurence Oliphant publishes The land of Gilead, with excursions in the Lebanon which proposes a settlement under British protection while respecting Ottoman sovereignty. He proposes that the 'warlike' Bedouins be driven out, and the Palestinians be placed in reservations like the native Indians of America.

1881–1884

Pogroms in the Russian Empire kill several Jews and injure large numbers, destroy thousands of Jewish homes, and motivate hundreds of thousands of Jews to flee.

1881–1920

Over two million of the Russian Jews emigrate. Most go to the U.S., others elsewhere, some to the Land of Israel. The first group of Biluim organize in Kharkov.

1881

Eliezer ben Yehuda makes aliyah and leads efforts to revive Hebrew as a common spoken language.

1882 January 1
Leon Pinsker publishes pamphlet Autoemancipation urging the Jewish people to strive for independence and national consciousness.

1882
Baron Edmond James de Rothschild begins buying land in the region of Palestine and financing Jewish agricultural settlements and industrial enterprises.

1882–1903
The First Aliyah, major wave (estimated at 25,000–35,000) of Jewish immigration to Ottoman-occupied Palestine.

1882
Rishon LeZion, Rosh Pinna, Zikhron Ya'akov are founded.

1883
Rabbi Isaac Rülf publishes Aruchas Bas-Ammi, calling for a Hebrew-speaking Jewish homeland in Palestine.

1884
Katowice Conference headed by Leon Pinsker

1890
Austrian publisher Nathan Birnbaum coins the term Zionism for Jewish nationalism in his journal Self Emancipation.

1890
The Russian Tsarist government approves the establishment of "The Society for the Support of Jewish Farmers and Artisans in Syria and Palestine", a charity organization which came to be known as "The Odessa Committee."

1891
Publication of the Blackstone Memorial petition

1894
The Dreyfus affair makes the problem of antisemitism prominent in Western Europe.

1896
After covering the trial and aftermath of Captain Dreyfus and witnessing the associated mass anti-semitic rallies in Paris, which included chants, "Death to Jews", Jewish-Austro-Hungarian journalist Theodor Herzl writes Der Judenstaat (The Jewish State) advocating the creation of a Jewish state.
1896–1904
Herzl, with the help of William Hechler, unsuccessfully approaches world leaders for assistance in the creation of a Jewish National Home but creates political legitimacy for the movement.

After the First Zionist Congress

1897
The First Zionist Congress in Basel, Switzerland, urges "a publicly and legally assured home in Palestine" for Jews and establishes the World Zionist Organization (WZO).

1897
The Zionist Organization of America (ZOA) is founded under the name Federation of American Zionists.

1898 January 13
The French writer Émile Zola exposed the Dreyfus affair to the general public in a famously incendiary open letter to President Félix Faure to which the French journalist and politician Georges Clemenceau affixed the headline "J'accuse!" (I accuse!). Zola's world fame and internationally respected reputation brought international attention to Dreyfus' unjust treatment.

1898
Sholom Aleichem writes a Yiddish language pamphlet Why Do the Jews Need a Land of Their Own?

1899
Henry Pereira Mendes publishes Looking Ahead: twentieth century happenings, the premise of which is that the restoration of Jewish sovereignty over historic Israel is essential to the world's peace and prosperity.

1901
Fifth Zionist Congress establishes the Jewish National Fund.

1902
Herzl publishes the novel Altneuland (The Old New Land), which takes place in Palestine.

1903–1906
More pogroms in Russian Empire. Unlike the 1881 pogroms, which focused primarily on property damage, these pogroms resulted in the deaths of at least 2,000 Jews and an even higher number of non-Jews.

1903
Uganda Proposal for settlement in East Africa splits the 6th Zionist Congress. A committee is created to look into it.

1904–1914

The Second Aliyah occurs. Approximately 40,000 Jews immigrated into Ottoman-occupied Palestine, mostly from Russia. The prime cause for the aliyah was mounting anti-Semitism in Russia and pogroms in the Pale of Settlement. Nearly half of these immigrants left Palestine by the time World War I started.

1909

Tel Aviv is founded on sand dunes near Jaffa. Young Judaea, a zionist youth movement, is founded.

1910–1916

Antisemitic Zionist conspiracy theories regarding the Ottoman Young Turk ruling elite are fuelled within the British government through diplomatic correspondence from Gerard Lowther (British Ambassador to Constantinople) and Gilbert Clayton (Chief of British intelligence in Egypt)

1915 January

Two months after the British declaration of war against the Ottomans, Herbert Samuel presents a detailed memorandum entitled: The Future of Palestine to the British Cabinet on the benefits of a British protectorate over Palestine to support Jewish immigration.

1915 October–1916 January

McMahon-Hussein Correspondence, agreeing to give Arabia to Arabs, if Arabs will fight the Turks. The Arab Revolt began in June 1916.

1916 May 16

Britain and France sign the secret Sykes-Picot Agreement which details the proposed division of Arabia at the conclusion of World War I into French and British spheres of influence.

1917 August

The formation of the Jewish Legion (Zion Mule Corps), initiated in 1914 by Joseph Trumpeldor and Zeev Jabotinsky.

1917

T.E. Lawrence leads Arab militias to defeat various Turkish Garrisons in Arabia.

1917 November 2

The British Government issues the Balfour Declaration which documented three main ideas:
First, it declared official support from the British Government for "the establishment in Palestine of a national home for the Jewish people", and promised that the British Government would actively aid in these efforts.

Second, it documented that the British Government would not support actions that would prejudice the civil and religious rights of the existing non-Jewish residents of Palestine.

Finally, it confirmed that Jews living in any other country would, similarly, not be prejudiced.

After the Balfour Declaration

1917 November 23

Bolsheviks release the full text of the previously secret Sykes-Picot Agreement in Izvestia and Pravda; it is subsequently printed in the Manchester Guardian on November 26.

1917 December

The British Army gains control of Palestine with military occupation, as the Ottoman Empire collapses in World War I.

1918–1920

Massive pogroms accompanied the Russian Revolution of 1917 (the Russian Civil War), resulting in the death of an estimated 70,000 to 250,000 civilian Jews throughout the former Russian Empire; the number of Jewish orphans exceeded 300,000.

1919–1923

The Third Aliyah was triggered by the October Revolution in Russia, the ensuing pogroms there and in Poland and Hungary, the British conquest of Palestine and the Balfour Declaration. Approximately 40,000 Jews arrived in Palestine during this time.

1920

The San Remo conference of the Allied Supreme Council in Italy resulted in an agreement that a Mandate for Palestine to Great Britain would be reviewed and then issued by the League of Nations. The mandate would contain similar content to the Balfour Declaration, which indicates that Palestine will be a homeland for Jews, and that the existing non-Jews would not have their rights infringed. In anticipation of this forthcoming mandate, the British military occupation shifts to a civil rule.

1920

Histadrut, Haganah, Vaad Leumi are founded.
Chaim Weizmann becomes new President of the WZO at the 12th Zionist Congress (the first since World War I).

1921
Britain grants autonomy to Transjordan under Crown Prince Abdullah.

1922 July
The offer of a Mandate for Palestine to Great Britain from the San Remo conference is confirmed by the League of Nations.

1923 September
Mandate for Palestine to Great Britain comes into effect.

1923
Britain cedes the Golan Heights to the French Mandate of Syria.

1923
Jabotinsky establishes the revisionist party Hatzohar and its youth movement, Betar.

1924
Palestine Jewish Colonization Association established by Edmond James de Rothschild

1924–1928
The Fourth Aliyah was a direct result of the economic crisis and anti-Jewish policies in Poland, along with the introduction of stiff immigration quotas by the United States. The Fourth Aliyah brought 82,000 Jews to British-occupied Palestine, of whom 23,000 left.

1927
The Zionist Federation of Australia is established in Melbourne.

1932–1939
The Fifth Aliyah was primarily a result of the Nazi accession to power in Germany (1933) and later throughout Europe. Persecution and the Jews' worsening situation caused immigration from Germany to increase and from Eastern Europe to continue. Nearly 250,000 Jews arrived in British-occupied Palestine during the Fifth Aliyah (20,000 of them left later). From this time on, the practice of "numbering" the waves of immigration was discontinued.

1933
Assassination of Haim Arlosoroff, a left-wing Zionist leader, thought to have been killed by right-wing Zionists
1933–1948
Aliyah Bet: Jewish refugees flee Germany because of persecution under the Nazi government with many turned away as illegal because of the British-imposed immigration limit.

1937
The British propose a partition between Jewish and Arab areas. It is rejected by both parties.

1936–1939
Great Uprising by Arabs against British rule and Jewish immigration.

1939
The British government issues the White Paper of 1939, which sets a limit of 75,000 on Jewish immigration to Palestine for the next five years and increases Zionist opposition to British rule.

1942 May
The Biltmore Conference makes a fundamental departure from traditional Zionist policy and demands "that Palestine be established as a Jewish Commonwealth" (state), rather than a "homeland." This sets the ultimate aim of the movement.

1944
The One Million Plan becomes official Zionist policy.

1947 November 29
The United Nations approves partition of Palestine into Jewish and Arab states. It is accepted by the Jews, but rejected by the Arab leaders.

1947 November 30
The 1947–1948 Civil War in Mandatory Palestine starts between Jewish forces, centered around the Haganah and Palestinians supported by the Arab Liberation Army.

1948 May 14
Declaration of the Establishment of the State of Israel

After the Declaration of Israel

1948 May 15
Five neighboring Arab countries invade, and the 1948 Arab-Israeli war ensues.

1949 January 7
The 1948 Arab-Israeli war ends.
1956 October 29 – 1956 November 7
Suez Crisis between Egypt on one side, and Britain, France and Israel on the other.

1967 June 5 – 1967 June 10
Six-Day War with Egypt, Jordan and Syria, assisted by forces from Iraq, Saudi Arabia, Morocco, Algeria, Libya, Tunisia, Sudan and the Palestine Liberation Organization against Israel.

1967 July – 1970 August 7
War of Attrition between Egypt and Israel.

1973 October 4 – 1973 October 25
Yom Kippur War with Egypt, Syria, Jordan and Iraq against Israel.

1975
The United Nations General Assembly Resolution 3379 equates Zionism with racism.

1979 March 26
Egypt–Israel Peace Treaty is signed by Egyptian President Anwar El Sadat and Israeli Prime Minister Menachem Begin.

1982 June – 1982 September
1982 Lebanon War with Syria and Lebanon against Israel.

1991
The UN GA resolution 3379 is revoked by Resolution 4686.

1993 August 20
The Oslo Accords are signed by Mahmoud Abbas of the Palestine Liberation Organization, Israeli Foreign Minister Shimon Peres, U.S. Secretary of State Warren Christopher and Russian Foreign Minister Andrei Kozyrev.

1994 October 26
Israel–Jordan peace treaty is signed by King Hussein I of Jordan and Israeli Prime Minister Yitzhak Rabin.

1995 November 4
Israeli Prime Minister Yitzhak Rabin is assassinated.

2006 July 12 — 2006 August 14
2006 Lebanon War between Lebanon and Israel.
### 19th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td></td>
<td>31 July</td>
<td>First Aliyah: Ten Hovevei Zion pioneers from Kharkiv established the city of Rishon LeZion in the Ottoman Empire.</td>
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<tr>
<td>1896</td>
<td>February</td>
<td>Theodor Herzl published Der Judenstaat, arguing for the establishment of an independent Jewish state.</td>
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<tr>
<td>1897</td>
<td>29 August</td>
<td>First Zionist Congress: A congress of some two hundred delegates of zionist organizations, most from Eastern Europe, convened in Basel.</td>
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<td></td>
<td>30 August</td>
<td>First Zionist Congress: The Congress adopted the Basel Program, setting out as the goal of the zionist movement the establishment of a Jewish homeland in Palestine.</td>
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### 20th century

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<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>1948</td>
<td>14 May</td>
<td>David Ben-Gurion, executive head of the World Zionist Organization and chairman of the Jewish Agency for Israel, issued the Israeli Declaration of Independence which declared the establishment of a Jewish state in the land of Israel to be known as the State of Israel.</td>
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<td></td>
<td>15 May</td>
<td>1948 Arab–Israeli War: Iraq, Egypt, Jordan and Syria invaded Israel.</td>
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<td>1949</td>
<td>25 January</td>
<td>1949 Israeli legislative election: Elections were held to a constituent assembly. Ben-Gurion's center-left Mapai won a plurality of seats.</td>
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<td></td>
<td>24 February</td>
<td>1949 Arab–Israeli War: The first of the 1949 Armistice Agreements ending the war was signed between Israel and Egypt. An armistice line was agreed along the prewar border with the exception that Egypt remained in control of the Gaza Strip.</td>
</tr>
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<td></td>
<td>8 March</td>
<td>The first government of Israel, in which Mapai, the Jewish United Religious Front, the liberal Progressive Party, the Sephardim and Oriental Communities and the Arab Democratic List of Nazareth ruled in coalition with Ben-Gurion as prime minister, was established.</td>
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<td></td>
<td>11 May</td>
<td>The General Assembly of the United Nations adopted United Nations General Assembly Resolution 273, according to which Israel was admitted to membership.</td>
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<td></td>
<td>13 December</td>
<td>Ben-Gurion proclaimed Jerusalem the capital of Israel.</td>
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<tr>
<td>1950</td>
<td>5 July</td>
<td>The Israeli legislature the Knesset passed the Law of Return, which granted all Jews the right to</td>
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<td>Year</td>
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<td>1956</td>
<td>26 July</td>
<td><strong>Suez Crisis</strong>: In a broadcast speech, Egyptian president Gamal Abdel Nasser gave a codeword order for the occupation and nationalization of the Suez Canal and the closure of the Straits of Tiran to Israeli shipping.</td>
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<tr>
<td>1960</td>
<td>11 May</td>
<td>Eight agents of the Israeli internal security service Shin Bet and its foreign intelligence service Mossad abducted Adolf Eichmann, the Nazi officer primarily responsible for the actual implementation of the Holocaust, near his home in San Fernando, Buenos Aires.</td>
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<td>1966</td>
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<td>The martial law imposed on Israeli Arabs from the founding of the State of Israel was lifted completely.</td>
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<td>1967</td>
<td>5 June</td>
<td><strong>Six-Day War</strong>: The Israeli air force destroyed the Egyptian air force on the ground over a period of three hours.</td>
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<td>1973</td>
<td>21 February</td>
<td>A Boeing 727-200 serving as Libyan Arab Airlines Flight 114 from Tripoli to Cairo was shot down over the Sinai Peninsula by Israeli fighter aircraft, killing over one hundred passengers and crew.</td>
</tr>
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<td>1973</td>
<td>21 July</td>
<td><strong>Lillehammer affair</strong>: A team of fifteen Mossad agents assassinated a Moroccan waiter in Lillehammer in a case of mistaken identity.</td>
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<td>1976</td>
<td>4 July</td>
<td><strong>Operation Entebbe</strong>: Sayeret Matkal freed some hundred hostages held at Entebbe International Airport by hijackers belonging to the Palestinian nationalist Popular Front for the Liberation of Palestine – External Operations and the far-left Revolutionary Cells.</td>
</tr>
<tr>
<td>1978</td>
<td>17 September</td>
<td>Israel and Egypt signed the Camp David Accords at the White House. The framework agreement provided for the establishment of an autonomous authority in the West Bank and Gaza Strip and for withdrawal of Israeli forces from the Sinai Peninsula in exchange for the establishment of full diplomatic relations with Egypt.</td>
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<td>Year</td>
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<tr>
<td>1979</td>
<td>26 March</td>
<td>Egypt and Israel signed the Egypt–Israel Peace Treaty under the framework of the Camp David Accords at the White House.</td>
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<tr>
<td>1980</td>
<td>24 February</td>
<td>The old Israeli shekel replaced the Israeli pound as the currency of Israel.</td>
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<td></td>
<td>30 July</td>
<td>The Knesset passed the Jerusalem Law, asserting that Jerusalem was and would remain the undivided capital of Israel.</td>
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<tr>
<td>1981</td>
<td>7 June</td>
<td>Operation Opera: Israel carried out a surprise air strike on an Iraqi nuclear reactor some ten miles southwest of Baghdad.</td>
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<tr>
<td>1982</td>
<td>23 April</td>
<td>The Israel Defense Forces (IDF) forcibly evacuated Yamit per the terms of the Egypt–Israel Peace Treaty.</td>
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<td></td>
<td>3 June</td>
<td>Shlomo Argov, the Israeli ambassador to the United Kingdom, was shot in the head in London in an attempted assassination organized by Iraq's Iraqi Intelligence Service and carried out by the Palestinian nationalist Abu Nidal Organization.</td>
</tr>
<tr>
<td></td>
<td>6 June</td>
<td>1982 Lebanon War: The IDF invaded southern Lebanon in response to repeated attacks by the Palestinian nationalist Palestine Liberation Organization (PLO), whose militants were sheltered there, on Israeli civilians.</td>
</tr>
<tr>
<td>1984</td>
<td>12 April</td>
<td>Bus 300 affair: Four Palestinian nationalists hijacked a bus from Tel Aviv to Ashkelon and took its forty passengers hostage.</td>
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<tr>
<td></td>
<td>13 April</td>
<td>Bus 300 affair: Sayeret Matkal forces stormed the bus. Two hijackers and one hostage were killed. The two surviving hijackers were taken to a nearby field and shot.</td>
</tr>
<tr>
<td></td>
<td>21 November</td>
<td>Operation Moses: The first of some eight thousand Ethiopian Jews were covertly evacuated to Israel from refugee camps in Sudan.</td>
</tr>
<tr>
<td>1985</td>
<td>5 January</td>
<td>Operation Moses: Prime minister Shimon Peres confirmed the existence of the airlift. Sudan immediately halted flights.</td>
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<tr>
<td>1987</td>
<td>30 August</td>
<td>The Cabinet voted to cancel development of the IAI Lavi.</td>
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<tr>
<td></td>
<td>9 December</td>
<td>First Intifada: Protests began in the Jabalia Camp in response to the death of four Palestinian civilians in a car crash with an IDF truck.</td>
</tr>
<tr>
<td>1989</td>
<td>19 September</td>
<td>Mount Carmel Forest Fire: A forest fire began on Mount Carmel which would burn over two square miles over the next three days.</td>
</tr>
<tr>
<td>1991</td>
<td>22 January</td>
<td>Gulf War: An Iraqi Scud missile landed in Ramat Gan, killing three and injuring nearly a hundred.</td>
</tr>
<tr>
<td></td>
<td>24 May</td>
<td>Operation Solomon: An airlift began which would transport some fourteen thousand Ethiopian Jews from Ethiopia to Israel over a thirty-six-hour period.</td>
</tr>
<tr>
<td></td>
<td>30 October</td>
<td>Madrid Conference of 1991: A conference opened in Madrid with the goal of reviving the Israeli–Palestinian peace process.</td>
</tr>
<tr>
<td>1992</td>
<td>17 December</td>
<td>Israel deported some four hundred Palestinians to Lebanon.</td>
</tr>
</tbody>
</table>
1993 13 September Israel and the PLO signed the Oslo I Accord in Washington, D.C. The accords provided for the withdrawal of some IDF forces from the West Bank and Gaza Strip and for the establishment of a self-governing authority for the Palestinians, the Palestinian National Authority.

1994 26 October Israel and Jordan signed the Israel–Jordan peace treaty in the Arabah. The treaty clarified the borders of the two countries and their water rights; each pledged that neither would allow a third country to use its territory to stage an attack on the other.

1995 4 November Assassination of Yitzhak Rabin: The radical nationalist Yigal Amir, an opponent of the Oslo Accords, shot and killed prime minister Yitzhak Rabin after a rally in Tel Aviv.

1997 4 February 1997 Israeli helicopter disaster: Two transport helicopters en route to southern Lebanon collided in midair above She'ar Yashuv, killing all on board.

14 July Maccabiah bridge collapse: A pedestrian bridge collapsed over the Yarkon River in Tel Aviv, killing four.

2000 24 May Israel withdrew the last of its forces from southern Lebanon.

1 October October 2000 events: The first of a series of riots began in which thirteen Arabs and one Jew would be killed over nine days.

7 October 2000 Hezbollah cross-border raid: The Lebanese Shia Islamist militant group and political party Hezbollah abducted three Israeli soldiers from the Israeli administered side of the Blue Line, the internationally recognized border.

21st century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>17 October</td>
<td>Assassination of Rehavam Ze'evi: Tourism minister Rehavam Ze'evi was shot at a Jerusalem hotel by Hamdi Quran of the Palestinian nationalist Popular Front for the Liberation of Palestine. He died of his injuries that night in hospital.</td>
</tr>
<tr>
<td>2002</td>
<td>23 June</td>
<td>Construction of the Israeli West Bank barrier began.</td>
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<tr>
<td>2004</td>
<td>29 January</td>
<td>Some four hundred prisoners, the remains of sixty Lebanese militants and civilians, and maps showing the locations of Israeli mines in southern Lebanon, were transferred to Hezbollah in exchange for the bodies of the three soldiers abducted in 2000, as well as the abducted Israeli reservist Ehhanan Tannenbaum.</td>
</tr>
<tr>
<td>2005</td>
<td>12 September</td>
<td>Israeli disengagement from Gaza: The last Israeli settlers and security personnel were withdrawn from the Gaza Strip.</td>
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<tr>
<td>2006</td>
<td>4 January</td>
<td>Prime minister Ariel Sharon suffered a severe hemorrhagic stroke and fell into a coma. The designated acting prime minister Ehud Olmert became acting prime minister.</td>
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<tr>
<td></td>
<td>12 July</td>
<td>2006 Hezbollah cross-border raid: Hezbollah forces crossed into Israel and ambushed two IDF vehicles, killing three soldiers and capturing two others.</td>
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<tr>
<td>Year</td>
<td>Month</td>
<td>Event</td>
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<tr>
<td>2006</td>
<td></td>
<td><strong>2006 Lebanon War</strong>: Israeli forces began shelling Lebanese territory in response to the Hezbollah attack of earlier that morning.</td>
</tr>
<tr>
<td>2007</td>
<td>September</td>
<td><strong>Operation Orchard</strong>: Israel carried out a surprise air strike on a suspected nuclear reactor in Syria's Deir ez-Zor Governorate.</td>
</tr>
<tr>
<td>2008</td>
<td>December</td>
<td><strong>Gaza War</strong>: Israel began conducting a series of airstrikes on assets of the Palestinian Sunni Islamist organization Hamas in the Gaza Strip in response to ongoing rocket fire on the western Negev.</td>
</tr>
<tr>
<td>2010</td>
<td>May</td>
<td><strong>Gaza flotilla raid</strong>: The navy boarded a flotilla organized by the Free Gaza Movement and the Turkish Foundation for Human Rights and Freedoms and Humanitarian Relief, which was attempting to break an Israeli and Egyptian blockade of the Gaza Strip, in international waters. During the takeover, a violent confrontation erupted on board the MV Mavi Marmara in which nine activists were killed.</td>
</tr>
<tr>
<td>2011</td>
<td>November</td>
<td><strong>Mount Carmel Forest Fire</strong>: A forest fire began on Mount Carmel which would kill forty and burn nearly twenty square miles over the next three days.</td>
</tr>
<tr>
<td>2011</td>
<td>July</td>
<td><strong>2011 Israeli social justice protests</strong>: Filmmaker Daphni Leef set up a tent in Habima Square and invited others to join a protest over the absence of affordable housing.</td>
</tr>
<tr>
<td>2011</td>
<td>September</td>
<td><strong>2011 attack on the Israeli Embassy in Egypt</strong>: A crowd of thousands of Egyptian protestors breached the Israeli embassy in Cairo.</td>
</tr>
<tr>
<td>2011</td>
<td>October</td>
<td><strong>Gilad Shalit prisoner exchange</strong>: Hamas released the Israeli soldier Gilad Shalit to Egypt in exchange for one thousand Palestinian other Arab prisoners held in Israel, including some three hundred serving life sentences for planning and perpetrating terror attacks.</td>
</tr>
<tr>
<td>2012</td>
<td>November</td>
<td><strong>Operation Pillar of Defense</strong>: The IDF began an eight-day anti-Hamas operation in the Gaza Strip, a response to ongoing rocket fire on the western Negev, with an airstrike on the senior officer Ahmed Jabari.</td>
</tr>
<tr>
<td>2014</td>
<td>July</td>
<td><strong>2014 Israel–Gaza conflict</strong>: The IDF launched a series of airstrikes against Hamas targets in the Gaza Strip.</td>
</tr>
<tr>
<td>2017</td>
<td>December</td>
<td><strong>United States recognition of Jerusalem as the capital of Israel</strong>: U.S. President Donald Trump formally announces the United States recognition of Jerusalem as the capital of Israel.</td>
</tr>
<tr>
<td>2019</td>
<td>March</td>
<td><strong>United States recognition of Israel's sovereignty over the Golan Heights</strong>: U.S. President Donald Trump signed a presidential proclamation to officially recognize Israel's sovereignty over the Golan Heights.</td>
</tr>
</tbody>
</table>

**Timeline of antisemitism**
**Antiquity**

740 BCE

The Assyrian captivity (or the Assyrian exile) is the period in the history of Ancient Israel and Judah during which several thousand Israelites of ancient Samaria were resettled as captives by Assyria. The Northern Kingdom of Israel was conquered by the Neo-Assyrian Empire.

586 BCE

During the reign of King Nebuchadnezzar II, the Neo-Babylonian Empire destroys the temple in Jerusalem, and captures the Kingdom of Judah and 10,000 Jewish families.

475 BCE

Haman attempts genocide against the Jews. (Purim).

175 BCE–165 BCE

The Deuterocanonical First and Second Books of the Maccabees record that Antiochus IV Epiphanes attempts to erect a statue of Zeus in Jerusalem. The festival of Hanukkah commemorates the uprising of the Maccabees against this attempt.

139 BCE

Gnaeus Cornelius Scipio Hispanus expels all Jews from the city of Rome.

124 BCE

The woman with seven sons was a Jewish martyr, described in 2 Maccabees 7 (2 Maccabees was written c. 124 BCE) and other sources. Although unnamed in 2 Maccabees, she is known variously as Hannah, Miriam, and Solomonia. 2 Maccabees states that shortly before the revolt of Judas Maccabeus (2 Maccabees 8), Antiochus IV Epiphanes arrested a mother and her seven sons, and tried to force them to eat pork. When they refused, he tortured and killed the sons one by one. The narrator mentions that the mother "was the most remarkable of all, and deserves to be remembered with special honour. She watched her seven sons die in the space of a single day, yet she bore it bravely because she put her trust in the Lord." Each of the sons makes a speech as he dies, and the last one says that his brothers are "dead under God's covenant of everlasting life". The narrator ends by saying that the mother died, without saying whether she was executed, or died in some other way.

The Talmud tells a similar story, but with the refusal to worship an idol replacing the refusal to eat pork. Tractate Gittin 57b cites Rabbi Judah saying that "this refers to the woman and her seven sons" and the unnamed king is referred to as the "Emperor" and "Caesar". The woman commits suicide in this rendition of the story: she "also went up on to a roof and threw herself down and was killed".
Other versions of the story are found in 4 Maccabees (which suggests that the woman might have thrown herself into the flames) and Josippon (which says she fell dead on her sons' corpses).

63 BCE

12,000 Jews die and many more are sent into the diaspora as a result of Pompey's conquest of the East.

59 BCE

Cicero criticizes Jews for being too influential in public assemblies. He also refers to Jews and Syrians as "races born to be slaves."

38 BCE

Anti-Jewish riots erupt in Alexandria, Egypt. Countless Jews are killed, synagogues are defiled, Jewish leaders are publicly scourged, and the Jewish population is confined to one quarter of the city.

First century

19 CE

Roman Emperor Tiberius expels Jews from Rome. Their expulsion is recorded by the Roman historical writers Suetonius, Josephus, and Cassius Dio.

37–41 CE

Thousands of Jews killed by mobs in the Alexandrian pogrom, as recounted by Philo of Alexandria in Flaccus.

50 CE

Jews are ordered by Roman Emperor Claudius "not to hold meetings", in the words of Cassius Dio (Roman History, 60.6.6). Claudius later expelled Jews from Rome, according to both Suetonius ("Lives of the Twelve Caesars", Claudius, Section 25.4) and Acts 18:2.

66–73 CE

The First Jewish–Roman War against the Romans is crushed by Vespasian and Titus. Titus refuses to accept a wreath of victory, because there is "no merit in vanquishing people forsaken by their own God." (Philostratus, Vita Apollonii). The events of this period were recorded in detail by the Jewish–Roman historian Josephus. His record is largely sympathetic to the Roman point of view and it was written in Rome under Roman protection; hence it is considered a controversial source. Josephus describes the Jewish revolt as being led by "tyrants," to the detriment of the city, and he describes Titus as having "moderation" in his escalation of the Siege of Jerusalem (70).

70 CE
Over 1,000,000 Jews perish and 97,000 are taken as slaves following the destruction of the Second Temple.

73 CE

Almost all historical information on Masada is from first-century Jewish Roman historian Josephus. A Roman governor had a legion lay siege to Masada, a mountain fortress. They built a 114 m (375 ft) high assault ramp, during probably two to three months of siege, and then breached the fortress with a battering ram on 16 April. According to Josephus, presumably based upon Roman commander commentaries accessible to him, when Romans entered the fortress they found its defendants had set all buildings but food storerooms ablaze and committed mass suicide or killed each other, 960 men, women, and children in total. Israel Defense Forces (IDF) Chief of staff, Moshe Dayan, began having the swearing-in ceremony of Armoured Corps soldiers on top of Masada, ending with, "Masada shall not fall again."

94 CE

Fabrications of Apion in Alexandria, Egypt, including the first recorded case of blood libel. Juvenal writes anti-Jewish poetry. Josephus picks apart contemporary and old antisemitic myths in his work Against Apion.

96 CE

Titus Flavius Clemens, nephew of the Roman Emperor Vespasian and supposed convert to Judaism is put to death on charges of atheism.

100 CE

Tacitus writes anti-Jewish polemic in his Histories (book 5). He reports on several old myths of ancient antisemitism (including that of the donkey's head in the Holy of Holies), but the key to his view that Jews "regard the rest of mankind with all the hatred of enemies" is his analysis of the extreme differences between monotheistic Judaism and the polytheism common throughout the Roman world.

Second century

115–117

Thousands of Jews are killed during civil unrest in Egypt, Cyprus, and Cyrenaica, as recounted by Cassius Dio.

119

Roman Emperor Hadrian bans circumcision, making Judaism de facto illegal.

132–135

Crushing of the Bar Kokhba revolt. According to Cassius Dio 580,000 Jews are killed. Hadrian orders the expulsion of Jews from Judea, which is merged with Galilee in order to form the province of Syria.
Palaestina. The purpose of this name change was to suppress the Jewish people's connection to their historic homeland (Judea / Land of Israel). (For other antisemitic actions resulting from this name change, see events of 1967 below) Although large Jewish populations remain in Samaria and Galilee, with Tiberias as the headquarters of exiled Jewish patriarchs, this is the start of the Jewish diaspora. Hadrian constructs a pagan temple to Jupiter at the site of the Temple in Jerusalem, builds Aelia Capitolina among the ruins of Jerusalem.

136

Hadrian renames Jerusalem to Aelia Capitolina and builds a Roman monument over the site of the Temple Mount. Jews are banned from visiting. Judea is renamed Palestine to suppress the Jewish connection with the land.

167

Earliest known accusation of Jewish deicide (the notion that Jews were held responsible for the death of Jesus), made in a sermon On the Passover, attributed to Melito of Sardis.

175

Apollinaris the Apologist writes two books against the Jews.

Third century

212

Emperor Caracalla allows all Jewish men within the Roman Empire to become full Roman citizens.

259

The Jewish community of Nehardea is destroyed.

Fourth century

306

The Synod of Elvira bans intermarriage between Christians and Jews. Other social intercourses, such as eating together, are also forbidden.

315

Constantine I enacts various laws regarding the Jews: Jews are not allowed to own Christian slaves or to circumcise their slaves. Conversion of Christians to Judaism is outlawed. Congregations for religious services are restricted, but Jews are also allowed to enter the restituted Jerusalem on the anniversary of the Temple's destruction.
325
Jews are expelled and banned from Jerusalem.

325
First Ecumenical Council of Nicaea. The Christian Church separates the calculation of the date of Easter from the Jewish Passover: "It was ... declared improper to follow the custom of the Jews in the celebration of this holy festival, because, their hands having been stained with crime, the minds of these wretched men are necessarily blinded.... Let us, then, have nothing in common with the Jews, who are our adversaries. ... avoiding all contact with that evil way. ... who, after having compassed the death of the Lord, being out of their minds, are guided not by sound reason, but by an unrestrained passion, wherever their innate madness carries them. ... a people so utterly depraved. ... Therefore, this irregularity must be corrected, in order that we may no more have any thing in common with those parricides and the murderers of our Lord. ... no single point in common with the perjury of the Jews."

330
Rabbah bar Nahmani is forced to flee to the forest where he dies.

339
Interrmarriage between Christians and Jews is banned in the Roman Empire, declaring the punishment death.

351
Book burning of Jewish texts in Persia.

351–352
Jewish revolt against Constantius Gallus. Jews rise up against the corrupt rule of Gallus. Many towns are destroyed, thousands are killed.

353
Constantius II institutes a law stating that any Christian who converts to Judaism will have their property confiscated.

361
Roman Emperor Julian the Apostate, allows the Jews to return to "Holy Jerusalem which you have for many years longed to see rebuilt" and to rebuild the Temple.

380
St. Gregory of Nysa calls Jews "murders of the Lord, assassins of the prophets, rebels and detesters of God, companions of the devils, a race of vipers."
361–363
Roman Emperor Julian the Apostate, allows the Jews to return to "holy Jerusalem which you have for many years longed to see rebuilt" and to rebuild the Temple.

386
John Chrysostom of Antioch writes eight homilies called Adversus Judaeos (lit: Against the Judaizers). See also: Christianity and antisemitism.

388
1 August: A Christian mob incited by the local bishop plunders and burns down a synagogue in Callinicum. Theodosius I orders that those responsible be punished, and the synagogue is rebuilt at the Christians' expense. Ambrose of Milan insists in his letter that the whole case be dropped. He interrupts the liturgy in the emperor's presence with an ultimatum that he will not continue until the case is dropped. Theodosius complies.

399
The Western Roman Emperor Honorius calls Judaism superstition indigna and confiscates gold and silver collected by the synagogues for Jerusalem.

Fifth century

408
Roman laws pass which prohibit Jews from setting fire to Haman, stating that they are mocking Christianity.

415
A Jewish uprising in Alexandria claims the lives of many Christians. Bishop Cyril forces his way into the synagogue, expels the Jews (some authors estimate the numbers of Jews expelled up to 100 thousand) and gives their property to the mob. Later, near Antioch, Jews are accused of ritual murder during Purim. Christians confiscate the synagogue. Jews call it "415 C.E. Alexandria Expulsion".

415
An edict issued by the Emperors Honorius and Theodosius II ban building new Synagogues and converting non-Jews to Judaism.

418
The first record of Jews being forced to convert or face expulsion. Bishop Severus of Menorca, claimed to have forced 540 Jews to accept Christianity upon conquering the island. The synagogue in Magona, now Port Mahon the capital of Menorca, is burned.
The monk Barsauma (not to be confused with the famous Bishop of Nisibis) gathers a group of followers and for the next three years, he destroys synagogues throughout the province of Palestine.

The final nasi of the ancient Sanhedrin Gamliel VI is executed by the Roman Empire. This subsequently ended the Jewish patriarchate.

The East Roman Emperor Theodosius II orders that all funds raised by Jews to support their schools be turned over to his treasury.

Theodosius II's wife visits Jerusalem, and arranges for Jews to visit and pray at the ruins of the Temple Mount. This leads to Jews emigrating to Jerusalem, where some are killed after being stabbed and stoned by local monks. At the trial for the deaths the monks claimed that the stones fell from heaven and thus they were acquitted.

The Codex Theodosianus, the first imperial compilation of laws. Jews are prohibited from holding important positions involving money, including judicial and executive offices. The ban against building new synagogues is reinstated. The anti-Jewish statutes also apply to the Samaritans. The Code is also accepted by Western Roman Emperor, Valentinian III.

Sassanid ruler Yazdegerd II of Persia's decree abolishes the Sabbath and orders executions of Jewish leaders, including the Exilarch Mar Nuna.

Council of Vannes, Gaul prohibited the Christian clergy from participating in Jewish feasts.

Half of the Jewish population of Isfahan is put to death and their children are brought up as 'fire-worshippers' over the alleged killing of two Magi Priests.

Exilarch Huna V is executed as a result of persecution under King Peroz (Firuz) of Persia.
Sixth century

502

After the Jews of Babylon revolt and gain a short period of independence, the Persian King Kobad crucifies the Exilarch Mar-Zutra II on the bridge of Mahoza.

506

Synagogue of Daphne is destroyed and its inhabitants are massacred by a Christian mob celebrating the result of a chariot race.

517

Christians are banned from participating in Jewish feasts as a result of the Council of Epaone.

519

Ravenna, Italy. After the local synagogues were burned down by the local mob, the Ostrogothic king Theodoric the Great orders the town to rebuild them at its own expense.

529–559

Byzantine Emperor Justinian the Great publishes Corpus Juris Civilis. New laws restrict citizenship to Christians. These regulations determined the status of Jews throughout the Empire for hundreds of years: Jewish civil rights restricted: "they shall enjoy no honors". The principle of Servitus Judaorum (Servitude of the Jews) is established: the Jews cannot testify against Christians. The emperor becomes an arbiter in internal Jewish matters. The use of the Hebrew language in worship is forbidden. Shema Yisrael ("Hear, O Israel, the Lord is one"), sometimes considered the most important prayer in Judaism, is banned as a denial of the Trinity. Some Jewish communities are converted by force, their synagogues turned into churches.

531

Emperor Justinian rules that Jews cannot testify against Christians. Jewish liturgy is censored for being "anti-trinitarian."

535

Synagogue of Berion is closed and all Jewish practices are prohibited by order of Justinian.

535

The First Council of Clermont (of Gaul) prohibits Jews from holding public office.

538
The Third Council of Orléans (of Gaul) forbids Jews to employ Christian servants or possess Christian slaves. Jews are prohibited from appearing in the streets during Easter: "their appearance is an insult to Christianity". A Merovingian king Childebert approves the measure.

547

Jews and Samaritans of Caesarea are massacred after revolting.

576


582

The Merovingians order that all Jews of the Kingdom are to be baptized.

589

The Council of Narbonne, Septimania, forbids Jews from chanting psalms while burying their dead. Anyone violating this law is fined 6 ounces of gold. The third Council of Toledo, held under Visigothic King Reccared, bans Jews from slave ownership and holding positions of authority, and reiterates the mutual ban on intermarriage. Reccared also rules children out of such marriages to be raised as Christians.

590

Pope Gregory I defends the Jews against forced conversion.

590–591

The Exilarch Haninai is executed by Khosrau II for supporting Mihrevandak. This halted all forms of Jewish self-governance for over 50 years.

592

The entire Jewish population of Antioch is punished because a Jew violated a law.

598

Bishop Victor of Palermo seizes the local synagogues and repurposes them into churches.

Seventh century

608–610

Massacres of Jews all across the Byzantine Empire.

610–620
After many of his anti-Jewish edicts were ignored, king Sisebur prohibits Judaism. Those not baptized fled. This was the first incidence where a prohibition of Judaism affected an entire country.

614

Fifth Council of Paris decrees that all Jews holding military or civil positions must accept baptism, together with their families.

614–617

The Jewish revolt against Heraclius. The last serious attempt to gain Jewish autonomy in the Land of Israel prior to modern times.

615

Italy. The earliest referral to the Juramentum Judaeorum (the Jewish Oath): the concept that no heretic could be believed in court against a Christian. The oath became standardized throughout Europe in 1555.

617

After breaking their promise of Jewish autonomy in Jerusalem, the Persians forbid Jews from settling within three miles of the city.

624

Mohammed watches as 600 Jews are decapitated in Medina in one day.

626–627

The Council of Clichy declared that any Jew who accepts public office must convert.

627

93 Jews are killed in the Battle of Khaybar.

629

Byzantine Emperor Heraclius with his army marches into Jerusalem. Jewish inhabitants support him after his promise of amnesty. Upon his entry into Jerusalem the local priests convince him that killing Jews is a good deed. The only Jews that survived were the ones who fled to Egypt or the mountains.

629

Frankish King Dagobert I, encouraged by Byzantine Emperor Heraclius, expels all Jews from the kingdom.

632

The first case of officially sanctioned forced baptism. Emperor Heraclius violates the Codex Theodosianus, which protected them from forced conversions.

634–641
Jews living in the Levant are forced to pay the Jizya as a result of the Muslim conquest of the Levant.

640

Jews expelled from Arabia.

642

The Jizya is imposed on the native Jews of Egypt, Cyrenaica, Tripolitania and Fezzan.

653

The Jews of Toledo are forced to convert or be expelled.

681

The Twelfth Council of Toledo enacts antisemitic laws.

682

Visigothic king Erwig begins his reign by enacting 28 anti-Jewish laws. He presses for the "utter extirpation of the pest of the Jews" and decrees that all converts must be registered by a parish priest, who must issue travel permits. All holidays, Christian and Jewish, must be spent in the presence of a priest to ensure piety and to prevent the backsliding.

692

Quinisext Council in Constantinople forbids Christians on pain of excommunication to bathe in public baths with Jews, employ a Jewish doctor or socialize with Jews.

694

17th Council of Toledo. King Ergica believes rumors that the Jews had conspired to ally themselves with the Muslim invaders and forces Jews to give all land, slaves and buildings bought from Christians, to his treasury. He declares that all Jewish children over the age of seven should be taken from their homes and raised as Christians.

Eighth century

717

Possible date for the Pact of Umar, a document that specified restrictions on Jews and Christians (dhimmi) living under Muslim rule. However, academic historians believe that this document was actually compiled at a much later date.

720

Caliph Omar II bans Jewish worship on the Temple Mount.
Byzantine emperor Leo III forcibly converts all Jews and Montanists in the empire into mainstream Byzantine Christianity.

First Archbishop of York Ecgbert bans Christians from eating with Jews.

Empress Irena decries the practice of forced conversion against Jews.

Idriss I attacks Jewish communities, imposes high per capita taxes, and forces them to provide annual virgins for his harem for refusing to attack other Jewish communities. According to Maghrebi tradition, the Jewish tribe Ubaid Allah left and settled in Djerba.

Ninth century

Abbassid Caliph Harun al-Rashid orders all Jews in the Caliphate to wear a yellow belt, with Christians to wear a blue one.

Agobard, Archbishop of Lyons, declares in his essays that Jews are accursed and demands a complete segregation of Christians and Jews. In 826 he issues a series of pamphlets to convince Emperor Louis the Pious to attack "Jewish insolence", but fails to convince the Emperor.

al-Mutawakkil made a decree ordering Dhimmi, Jews and Christians, wear garments to distinguish them from Muslims, their places of worship destroyed, demonic effigies nailed to the door, and that they be allowed little involvement government or official matters.

Ahmad ibn Tulun flattens Jewish cemeteries and replaces them with Muslim tombs.

Basil I decrees that all Byzantine Jews are to be baptized, by force if necessary.

Basil I reinforces law that prohibits Jews from holding any civil or military position in Epanagoge.
Church council in Metz forbids Christians and Jews from eating together.

Charles the Simple donates all Jewish owned land to the Bishop of Narbonne. There is no recourse against the action.

**Tenth century**

**900–929**

French king Charles the Simple confiscates Jewish-owned property in Narbonne and donates it to the Church.

**925**

Jews of Oria are raided by a Muslim mob during a series of attacks on Italy. At least ten rabbinical leaders and many more are taken as captives. Among those captured is 12-year-old Shabbetai Donnolo, who would go on later to be a famous physician and astronomer.

**931**

Bishop Ratherius of Verona begs the town elders to expel the Jews from the city until they agree to temporarily expel them.

**931–942**

Romanos I Lekapenos decreed that all Jews should be forced to convert and subjugated if they refuse. This leads to the death of hundreds of Jews and the destruction of numerous synagogues.

**932**

The Jewish quarter of Bari, Italy is destroyed by a mob and a number of Jews are killed.

**943–944**

Byzantine Jews from all over the Empire flee from persecution into Khazaria. The King of Khazaria at the time, who was Jewish, subsequently cut ties with the Byzantine Empire.

**945**

Venice bans Jews from using Venetian vessels.

**985**

Entire Jewish population of Sparta is expelled after Nikon the Metanoeite says it will rid the city of a plague.
A number of Jewish residents in Barcelona are killed by the Muslim leader Almanzor. All Jewish owned land is handed over to the Count of Barcelona.

Eleventh century

1008
Caliph Al-Hakim bi-Amr Allah ("the Mad") issues severe restrictions against Jews in the Fatimid Empire. All Jews are forced to wear a heavy wooden "golden calf" around their necks. Christians had to wear a large wooden cross and members of both groups had to wear black hats.

1009
Caliph Abu Ali-Mansur orders the destruction of synagogues, Torah scrolls and Jewish artifacts among other non-Muslim buildings.

1010
The Jews of Ligomes are given the choice of baptism or exile.

1011
The Abbasid Caliph Al-Qadir publishes the Baghdad Manifesto, which accuses the Fatimids of being descended from Jews, instead of being "family of the prophet."

1011
A Muslim mob attacks a Jewish funeral procession, resulting in the arrest of 23 Jews.

1011
Pogrom against Sephardic Jews in Córdoba by a Muslim mob.

1012
One of the first known persecutions of Jews in Germany: Henry II, Holy Roman Emperor expels Jews from Mainz.

1013
During the fall of the city, Sulayman's troops looted Córdoba and massacred citizens of the city, including many Jews. Prominent Jews in Córdoba, such as Samuel ibn Naghrela were forced to flee to the city in 1013.

1016
The Jewish community of Kairouan, Tunisia is forced to choose between conversion and expulsion.
A violent earthquake occurs, which some Greeks maintain is caused by a desecration of Jesus by the Jews. For this a number of Roman Jews are burnt at the stake.

Probable date of the chronicle of Raoul Glaber. The French chronicler blamed the Jews for the destruction of the Church of the Holy Sepulchre, which was destroyed in 1009 by (Muslim) Caliph Al-Hakim. As a result, Jews were expelled from Limoges and other French towns.

Abul Kamal Tumin conquers Fez, Morocco and decimates the Jewish community, killing 6,000 Jews.

Following their conquest of the city from the Maghrawa tribe, the forces of Tamim, chief of the Zenata Berber Banu Ifran tribe, perpetrated a massacre of Jews in Fez. Fez massacre

Sixty Jews are put to death in Castrojeriz during a revolt, because the Jews were considered "property" of the kingdom by the locals.

A Muslim mob raids the palace of the Jewish vizier and kills him after the ruler al-Mondhir is assassinated.

Exilarch Hezekiah Gaon is imprisoned and tortured to death by the Buyyids. The death of Hezekiah ended the line of the Geonim, which had begun four centuries earlier.

Council of Narbonne, France forbids Christians to live in Jewish homes.

Granada massacre: Muslim mob stormed the royal palace in Granada, crucified Jewish vizier Joseph ibn Naghrela and massacred most of the Jewish population of the city. "More than 1,500 Jewish families, numbering 4,000 persons, fell in one day."

Jerusalem falls to the Seljuk Turks, lots of synagogues are destroyed and life for Jews in Jerusalem becomes much more restricted.

Granada massacre;
Council of Girona decrees Jews to pay taxes for support of the Catholic Church to the same extent as Christians.

1090

The Jewish community of Granada, which had recovered after the attacks of 1066, attacked again at the hands of the Almoravides led by Yusuf ibn Tashfin, bringing the golden age of Jewish culture in Spain to end.

1092

Jews are prohibited from working on Sunday or marrying Christians as a result of the Synod of Szabolcs.

1096

The First Crusade. Three hosts of crusaders pass through several Central European cities. The third, unofficial host, led by Count Emicho, decides to attack the Jewish communities, most notably in the Rhineland, under the slogan: "Why fight Christ's enemies abroad when they are living among us?" Eimicho's host attacks the synagogue at Speyer and kills all the defenders. 800 are killed in Worms. Another 1,200 Jews commit suicide in Mainz to escape his attempt to forcibly convert them; see German Crusade, 1096, and 600 are massacred in Mainz on 27 May. Attempts by the local bishops remained fruitless. All in all, 5,000 Jews were murdered.

1099

Jews fight side-by-side with Muslim soldiers to defend Jerusalem against the Crusaders and face massacres when it falls. According to the Muslim chronicle of Ibn al-Qalanisi, "The Jews assembled in their synagogue, and the Franks burned it over their heads." However, a contemporary Jewish communication does not corroborate the report that Jews were actually inside of the Synagogue when it was set on fire. This letter was discovered among the Cairo Geniza collection in 1975 by historian Shelomo Dov Goitein. Historians believe that it was written just two weeks after the siege, making it "the earliest account on the conquest in any language." However, all sources agree that a synagogue was indeed burned during the siege.

Twelfth century

1106

Son of Yusuf ibn Tashfin decrees the death penalty for any Jews living in Marrakesh.

1107

Moroccan Almoravid ruler Yusuf ibn Tashfin ordered all Moroccan Jews to convert or leave.
Many Jews are massacred and their houses and synagogues are burned following a Muslim victory at the Battle of Uclés (1108). Of those murdered is Solomon ibn Farissol, the leader of the Castile community. This incident greatly impacted the Hebrew poet Judah HaLevi, and completely shifted the focus of his poetry.

1113

Upon the death of Sviatopolk II, leader of the Kievan Rus', widespread riots and plundering of Jewish homes commenced.

1124

The Jewish Quarter of Kiev is destroyed by arson.

1135

A Muslim mob in Córdoba storms into Jewish homes, takes their possessions and kills a number of them.

1141

During the fight for succession between Matilde and Stephen (The Anarchy), the Jews of Oxford are forced to pay ransom to both sides of the conflict or their houses are to be burned.

1143

150 Jews are killed in Ham, France.

1144

The case of William of Norwich, a contrived accusation of murder by Jews in Norwich, England.

1145

Abd al-Mu'min gives the Jewish population of Sijilmasa the choice of converting to Islam or death. At least 150 Jews who refuse to convert are massacred.

1146

100,000 Jews are massacred by the Almohads in Fez, Morocco and 120,000 in Marrakesh.

1147

Jews are expelled from Muslim Spain.

1148

The mostly-Jewish town Lucena is captured by the Almohads. The local Jews are given the choice of Islam or death. This was the end of the Jewish community of Lucena.

1148–1212
The rule of the Almohads in al-Andalus. Only Jews who had converted to Christianity or Islam were allowed to live in Granada. One of the refugees was Maimonides, who settled in Fez and later in Fustat near Cairo.

1160

Appalled by the annual practice of beating Jews during Palm Sunday, Bishop William issues an order which would excommunicate any priest who continues the practice.

1165

Forced mass conversions in Yemen.

1165

New Almohad ruler decrees that all Jews in Fez must convert to Islam or face death. Judah ha-Kohen ibn Shushan is burnt alive for refusing, and famous Rabbi Maimonides is displaced and permanently leaves for Egypt.

1168

Harold of Gloucester is found floating in a river. The local Benedictine monks use the discovery to claim that "the child had been spirited away by the Jews on the 21st February for them to torture him to death on the night of 16th March". It established that the mythology created around William's death could be used as a template for explaining later deaths.

1171

In Blois, France 31 Jews were burned at the stake for blood libel.

1171

Jews of Bologna are expelled for no known reason.

1173

Following multiple church-inspired riots against the Jews of Poland, Mieszko III forbids all kinds of violence against the Jews.

1177

King Alfonso II, Spain, creates a charter which defines the status of Jews in Teruel. Jews are defined as "slaves of the king, belonging entirely to the royal treasury." The fee for killing a Jew is half of what the fee is for killing a Christian, and is to be paid directly to the king (since Jews are considered property of the crown).
The Third Lateran Council, Canon 26: Jews are forbidden to be plaintiffs or witnesses against Christians in the courts. Jews are forbidden to withhold inheritance from descendants who had accepted Christianity.

1179

The body of a Christian girl is found near the shore. The Jews of Boppard are blamed for her death, resulting in 13 Jews being murdered.

1180

Philip Augustus of France after four months in power, imprisons all the Jews in his lands and demands a ransom for their release.

1181

Philip Augustus annuls all loans made by Jews to Christians and takes a percentage for himself. A year later, he confiscates all Jewish property and expels the Jews from Paris.

1181

The Assize of Arms of 1181 orders that all weapons held by Jews must be confiscated, claiming they have no use for them. This led to the Jewish community of England being a lot more vulnerable during Anti-Jewish riots.

1182

Jews are expelled from Orléans.

1184

Jewish martyr Elhanan, the son of Ri is murdered for refusing to convert.

1188

The Saladin tithe. Jews are taxed 25% of their income and personal worth, while Christians are taxed 10%.

1189

Holy Roman Emperor Frederick I Barbarossa orders priests not to preach against Jews.

1189

A Jewish deputation attending coronation of Richard the Lionheart was attacked by the crowd. Pogroms in London followed and spread around England.

1190

All the Jews of Norwich, England found in their houses were slaughtered, except a few who found refuge in the castle.
57 Jews in St. Edmunds are killed in a massacre on Palm Sunday.

1190

500 Jews of York were massacred after a six-day siege by departing Crusaders, backed by a number of people indebted to Jewish money-lenders.

1190

Saladdin takes over Jerusalem from Crusaders and lifts the ban for Jews to live there.

1191

More than 80 Jews in Bray-sur-Seine are burned at the stake after trying to execute a murderer who had killed an Israelite.

1195

After falsely being accused of ritual murder with no evidence, the daughter of Rabbi Isaac bar Asher ha-Levi is murdered, dismembered and her body parts are hung around the market place for days. Ha-Levi was killed the following day along with 8 other Jews after trying to recover what was left of his daughter's body from the mob.

1197

In an attempt to isolate the Jewish population economically, Christians were barred from buying food from Jews or having conversations with them under the threat of excommunication.

1198

Philip Augustus readmits Jews to Paris, only after another ransom was paid and a taxation scheme was set up to procure funds for himself. August: Saladdin's nephew al-Malik, caliph of Yemen, summons all the Jews and forcibly converts them.

Thirteenth century

1203

Jewish quarter of Constantinople is burned down by crusaders during the Siege of Constantinople (1203).

1204

In 1204 the papacy required Jews to segregate themselves from Christians and to wear distinctive clothing.

1205

Jews are expelled from villages and towns all around Spain by Muslims.

1206
Jewish homes are burned, looted, Israelites are killed and the remaining Jewish population of Halle is expelled.

1209

Béziers is stormed and its inhabitants are massacred. Among those were 200 Jews. All Jewish children who survived and didn't flee were forcibly baptized.

1209

Raymond VI, Count of Toulouse, humiliated and forced to swear that he would implement social restrictions against Jews.

1210

King John of England imprisoned much of the Jewish population until they paid up 66,000 marks.

1212

Forced conversions and mass murder of the Jewish community of Toledo.

1215

The Fourth Lateran Council headed by Pope Innocent III declares: "Jews and Saracens of both sexes in every Christian province and at all times shall be marked off in the eyes of the public from other peoples through the character of their dress." (Canon 68). See Judenhut. The Fourth Lateran Council also noted that the Jews' own law required the wearing of identifying symbols. Pope Innocent III also reiterated papal injunctions against forcible conversions, and added: "No Christian shall do the Jews any personal injury...or deprive them of their possessions...or disturb them during the celebration of their festivals...or extort money from them by threatening to exhume their dead."[161]

1217

French noblewoman Alix de Montmorency imprisons the Jewish population of Toulouse for refusing to convert. She eventually released them all except for children under six, who were taken and adopted by Christians.

1221

An anti-Jewish riot erupts in Erfurt, where the Jewish quarter is destroyed along with two synagogues. Around 26 Jews are killed, and others throw themselves into fire rather than be forcibly converted. Samuel of Speyer was among those martyred.

1222

1223

Louis VIII of France prohibits his officials from recording debts owed to Jews, reversing his father's policy of seeking such debts.

1227

The Synod of Narbonne reaffirms the anti-Semitic decrees of the Fourth Lateran Council.

1229

Raymond VII, Count of Toulouse, heir of Raymond VI, also forced to swear that he would implement social restrictions against Jews.

1229

Treaty of Jaffa is signed between Frederick II and the Sultan Al-Kamil of Egypt. Jews are once again banned from residing in Jerusalem.

1230

Theodore Komnenos Doukas is defeated. Since Theodore decreed many anti-Jewish laws and seized Jewish property, he was handed over to two Jews by John Asen II to personally kill him. After having pity on him and refusing to kill Theodore, the Czar had the Jews thrown off a cliff.

1232

Forced mass conversions in Marrakesh, over 1,000 Moroccan Jews are killed.

1235

The Jews of Fulda, Germany were accused of ritual murder. To investigate the blood libel, Emperor Frederick II held a special conference of Jewish converts to Christianity at which the converts were questioned about Jewish ritual practice. Letters inviting prominent individuals to the conference still survive. At the conference, the converts stated unequivocally that Jews do not harm Christian children or require blood for any rituals. In 1236 the Emperor published these findings and in 1247 Pope Innocent IV, the Emperor's enemy, also denounced accusations of the ritual murder of Christian children by Jews. In 1272, the papal repudiation of the blood libel was repeated by Pope Gregory X, who also ruled that thereafter any such testimony of a Christian against a Jew could not be accepted unless it is confirmed by another Jew. Unfortunately, these proclamations from the highest sources were not effective in altering the beliefs of the Christian majority and the libels continued.

1236

Crusaders attack Jewish communities of Anjou and Poitou and attempt to baptize all the Jews. Those who resisted (est. 3,000) were slaughtered.
A Jew and a Christian fisherman get into a heated argument about prices, which turns physical. It ends when the Jew deals a devastating blow to the Gentile's head which leads to his death. This enrages the local Christian population, who attack the Jewish quarter of Narbonne. Don Aymeric, the governor of Narbonne prevents a massacre and restores all stolen Jewish property to their rightful owner.

1240

Duke Jean le Roux expels Jews from Brittany.

1240

Disputation of Paris. Pope Gregory IX puts Talmud on trial on the charges that it contains blasphemy against Jesus and Mary and attacks on the Church.

1241

A pogrom against the Jews of Frankfurt takes place after conflicts over Jewish-Christian marriages and the enforced baptism of interfaith couples. 180 Jews are killed as a result and 24 agree to be baptized. This became known as the Judenschlacht (German for Slaughter of the Jews).

1241

In England, first of a series of royal levies against Jewish finances, which forced the Jews to sell their debts to non-Jews at cut prices.

1242

24 cart-loads of hand-written Talmudic manuscripts burned in the streets of Paris.

1242

James I of Aragon orders Jews to listen to conversion sermons and to attend churches. Friars are given power to enter synagogues uninvited.

1243

The first ever accusation of Host Desecration. The entire Jewish population of Beelitz was burned at the stake after being accused of torturing Jesus and the spot it happened was named "Judenberg."

1243

11 Jews are tortured to death following a blood libel in Kitzingen Germany.

1244

Pope Innocent IV orders Louis IX of France to burn all Talmud copies.

1249

Alphonse of Poitiers orders the expulsion of all Jews in Poitou.
1250

**Saragossa, Spain:** death of a choirboy *Saint Dominguito del Val* prompts ritual murder accusation. His sainthood was revoked in the 20th century but reportedly a chapel dedicated to him still exists in the Cathedral of Saragossa.

1253

**Henry III of England** introduces harsh anti-Jewish laws.

1254

Louis IX expels the Jews from France, their property and synagogues confiscated. Most move to Germany and further east, however, after a couple of years, some were readmitted back.

1255

Henry III of England sells his rights to the Jews (regarded as royal "chattels") to his brother Richard for 5,000 marks.

1257

The Badge of shame is imposed locally on the Italian Jews.

1260

Mongols are defeated and Syria is brought under Mamluk rule. Anti-Jewish laws are once again decreed, and Jewish life becomes a lot more restricted in the Levant.

1260

Jews are banned from ascending above the 7th step on the Cave of the Patriarchs. This ban would last 700 years.

1260

Thomas Aquinas publishes *Summa Contra Gentiles*, a summary of Christian faith to be presented to those who reject it. The Jews who refuse to convert are regarded as "deliberately defiant" rather than "invincibly ignorant".

1263

Disputation of Barcelona.

1264

Pope Clement IV assigns Talmud censorship committee.

1264

Simon de Montfort inspires massacre of Jews in London.
1265

German-Jewish convert Abraham of Augsburg publicly assails Christianity, severs the heads of crucifix figurines and is sentenced to torture and death by burning.

1267

In a special session, the Vienna city council forces Jews to wear Pileum cornutum (a cone-shaped headdress, prevalent in many medieval illustrations of Jews). This distinctive dress is an addition to Yellow badge Jews were already forced to wear. Christians are not permitted to attend Jewish ceremonies.

1267

Synod of Breslau orders Jews to live in a segregated quarter.

1267

After an accusation from an old woman that the Jews had bought a Christian child from her to kill, the entire Jewish community of Pforzheim face massacres and expulsion. Rabbi Samuel ben Yakar ha-Levi, Rabbi Isaac ben Eliezer and Rabbi Abraham ben Gershom commit suicide to escape the cruel torture they feared.

1275

King Edward I of England passes the Statute of the Jewry forcing Jews over the age of seven to wear an identifying yellow badge, and making usury illegal, in order to seize their assets. Scores of English Jews are arrested, 300 hanged and their property goes to the Crown. In 1280 he orders Jews to be present as Dominicans preach conversion. In 1287 he arrests heads of Jewish families and demands their communities pay ransom of 12,000 pounds.

1276

Massacre in Fez to kill all Jews stopped by intervention of the Emir

1278

The Edict of Pope Nicholas III requires compulsory attendance of Jews at conversion sermons.

1279

Synod of Ofen: Christians are forbidden to sell or rent real estate to or from Jews.

1282

John Pectin, Archbishop of Canterbury, orders all London synagogues to close and prohibits Jewish physicians from practicing on Christians.

1283

Philip III of France causes mass migration of Jews by forbidding them to live in the small rural localities.
1283

10 Jews are slain in Mainz after claims of blood libel.

1285

Blood libel in Munich, Germany results in the death of 68 Jews. 180 more Jews are burned alive at the synagogue.

1287

A 16-year-old boy is found dead in the Rhine. Immediately the Jews of Oberwesel are accused of killing the boy. Over 40 men, women and children were killed by rioters as a response.

1287

Jews are arrested and accused of coin clippage. Even without evidence, the whole community is convicted and expelled.

1288

The Jewish population of Troyes is accused of ritual murder. 13 Jewish martyrs are burned at the stake, sacrificing themselves to spare the rest of the community.

1288

104 Jews in Bonn, Germany are killed during a pogrom.

1289

Jews are expelled from Gascony and Anjou.

1290

Edict of Expulsion: Edward I expels all Jews from England, allowing them to take only what they could carry, all the other property became the Crown’s. Official reason: continued practice of usury.

1290

A Jewish man named Jonathan and his wife are accused of stabbing the wafer to torture Jesus. They are both burned at the stake, their house is destroyed and replaced with a chapel.

1290

The Jews of Baghdad are massacred.

1290

18 July Edward I of England issues Edict of Expulsion, decreeing all Jews to be expelled from England.

1291

Philip the Fair publishes an ordinance prohibiting the Jews to settle in France.
Jewish physician and grand vizier Sa'ad al-Dawla is killed by Muslims who felt it a degradation to have a Jew placed over them. Persian Jews suffer a long-period of violent persecution by the Muslim population.

Forced conversion and expulsion of the Italian Jewish community.

Accusations of Host desecration against the German Jews. More than 140 Jewish communities face forced conversions.

During the civil war between Adolph of Nassau and Albrecht of Austria, German knight Rintfleisch claims to have received a mission from heaven to exterminate "the accursed race of the Jews". Under his leadership, the mob goes from town to town destroying Jewish communities and massacring about 100,000 Jews, often by mass burning at stake. Among 146 localities in Franconia, Bavaria and Austria are Röttingen (20 April), Würzburg (24 July), Nuremberg (1 August).

Fourteenth century

Riots break out in Egypt, which are encouraged by the Mamluks. Many Jews are forcibly converted to Islam, including the entire Jewish population of Bilbeis. Many synagogues are appropriated into mosques.

Philip IV of France seizes all Jewish property (except the clothes they wear) and expels them from France (approx. 100,000). His successor Louis X of France allows French Jews to return in 1315.

Jews of Sens are expelled.

Jews expelled from Castelsarrasin, France.

Frederick II of Aragon adopts anti-Jewish laws, which require them to mark their clothes and shops with the yellow badge. Jews were also forbidden from having any relationship with Catholics.
Rashid-al-Din Hamadani, a Persian Jewish convert to Islam was executed on fake charges of poisoning Öljeitü and for several days crowds carried his head around his native city of Tabriz, chanting "This is the head of the Jew who abused the name of God; may God's curse be upon him!"

1319
Jews are expelled from Breslau.

1320
Jews are expelled from Milan during a persecution of so-called heretics.

1320
152 Jews massacred in Castelsarrasin, France.

1320
Shepherds' Crusade attacks the Jews of 120 localities in southwest France.

1321
King Henry II of Castile forces Jews to wear Yellow badge.

1321
Jews in central France accused of ordering lepers to poison wells. After massacre of est. 5,000 Jews, King Philip V admits they were innocent.

1321
A Muslim mob destroys a synagogue in Damascus.

1322
King Charles IV expels Jews from France.

1328
5,000 Jews are massacred and their houses are burned down following anti-Jewish preaching by a Franciscan friar.

1328
Jewish martyr Aaron ben Zerah, along with his wife and four of his sons are executed.

1333
Forced mass conversions in Baghdad

1336
Persecutions against Jews in Franconia and Alsace led by lawless German bands, the Armleder under the highwayman Arnold von Uissigheim. Roughly 1500 Jews are killed.

1336

The Aleinu prayer is banned in Castile.

1337

Host desecration accusations. Violence spreads to over 51 Jewish communities.

1338

Pogroms over host desecration in Wolfsberg. The Jews are accused of stealing the bread of the Eucharist and trying to burn it. Over 70 Jews are burned at the stake and the entire Jewish community is destroyed.

1343

Pre-Easter massacres spread from Germany across Western Europe. Jews fleeing persecution are welcomed in Poland by Casimir the Great.

1344

The citizens ask the King's permission to confiscate the houses of the Jews for the cities benefit – he grants their request.

1348

European Jews are blamed for the plague in the Black Death persecutions. Charge laid to the Jews that they poisoned the wells. Massacres spread throughout Spain, France, Germany and Austria. More than 200 Jewish communities destroyed by violence. Many communities have been expelled and settle down in Poland.

1349

**Basel:** 600 Jews burned at the stake, 140 children forcibly baptized, the remaining city's Jews expelled. The city synagogue is turned into a church and the Jewish cemetery is destroyed.

1349

burning of Jews (from a European chronicle written on the Black Death between 1349 and 1352)

1349

The Erfurt massacre was a massacre of around 3,000 Jews as a result of Black Death Jewish persecutions
The entire Jewish population of Speyer is destroyed. All Jews are either killed, converted, or fled. All their property and assets was confiscated. Part of the Black Death Jewish persecutions.

1349

600 Jews are burned at the stake and the entire Jewish community of Zurich is annihilated as a part of the Black Death Jewish persecutions.

1349

The Jewish community of Worms is completely destroyed as a result of the Black Death Jewish persecutions. Hundreds of Jews set fire to their homes to avoid the oncoming torture. Their property was seized by the locals.

1349

Jews of Berlin are expelled and many are killed as a part of the Black Death Jewish persecutions.

1349

Jews of Breslau are expelled as part of the Black Death Jewish persecutions.

1349

60 Jews are murdered in Breslau. The city claims all property and synagogues, while the Emperor was given the cemetery and all Jewish debts.

1349

The Jewish quarter of Cologne is destroyed by an angry mob, and the most of the community is killed. All of their property was split up between the ransackers. It was part of the Black Death Jewish persecutions.

1349

The Strasbourg massacre was a part of the Black Death persecutions, where several hundred Jews were publicly burned to death, and the rest of them were expelled. It was one of the first and worst pogroms in pre-modern history.

24 August 1349

6,000 Jews are burned to death in Mainz as a part of the Black Death Jewish persecutions. When the angry mob charged, the Jews initially fought back, killing around 200 of their attackers.

1350

Brussels Jewish community is decimated after they are blamed for the Plague.

1352

Church officials order the expulsion of Jews from Bulgaria for "heretical activity."

979
1354
12,000 Jews are massacred throughout Spain following a bloody civil war.

1359
Charles V of France allows Jews to return for a period of 20 years in order to pay ransom for his father John II of France, imprisoned in England. The period is later extended beyond the 20 years.

1360
Jews are expelled from Breslau.

1360
Furious with a pogrom against Castilian Jews in Miranda de Ebro, Peter of Castile publicly boils one of the perpetrators, roasts another, and executes others with an axe.

1360
Sephardic Jew Samuel ben Meir Abulafia is arrested and tortured to death in prison for no apparent reason. His lands are confiscated by the king.

1365
Jews of Lorraine are expelled after their presence is cited as the cause of lightning strikes which destroyed twenty-two houses.

1367
Host desecration trials are held against the Jews of Barcelona. They were initiated by the crown prince Don Juan of Aragon.

1368
Some 6,000 Jews are killed during a siege in Toledo.

1370
The entire Jewish population of Brussels is massacred over allegations of host desecration. It was an end of the Hebrew community in Brussels. The event was commemorated by local Christians as the Sacrament of Miracle.

1376
Jews from expelled from Hungary. Most of them flee south into Greece and neighboring areas.

1377
Another Host desecration trial is held against Jews in Teruel and Huesca. The person behind it, as with the previous trial, is the crown prince Don Juan of Aragon. Many Jews are tortured and burned alive publicly.
1382
16 Jews are murdered in the Mailotin Riots.

1384
200 Jews are killed in Noerdlingen and the community ceases to exist.

1386
Wenceslaus, Holy Roman Emperor, expels the Jews from the Swabian League and Strasbourg and confiscates their property.

1385
John of Castile reinforces previous anti-Jewish legislation.

1385
All Jews in the Swabian League are arrested, and their books are confiscated.

1389
18 March, a Jewish boy is accused of plotting against a priest. The mob slaughters approx. 3,000 of Prague's Jews, destroys the city's synagogue and Jewish cemetery. Wenceslaus insists that the responsibility lay with the Jews for going outside during Holy Week.

1391
Anti-Jewish riots led by Ferrand Martinez erupt in Seville.

1391
Led by Ferrand Martinez, countless massacres devastate the Sephardic Jewish community, especially in Castile, Valencia, Catalonia and Aragon. The Jewish quarter in Barcelona is completely destroyed. By the end of the pogroms, at least 10,000 Jews are murdered and thousands more are forcibly converted.

1391
Pogrom against the Jews of Toledo on the Seventeenth of Tammuz. Jewish martyrs Israel Alnaqua and Judah ben Asher died at the stake together.

1391
Over 250 Jews are massacred by a mob in Valencia.

1391
All Jewish inhabitants of Palma, Majorca are either converted or killed.

1391
More than 400 Jews are massacred in Barcelona.
1392

The Jews of Damascus are accused by Muslims of setting fire to the central mosque. Although there was no evidence presented, one Jew was burned alive, the leaders of the community were tortured, and the local synagogue was appropriated into a mosque.

1392

Sicilian Jews are forced to live in Ghettos and severe persecution breaks out in Erice, Catania and Syracuse.

1394

3 November, Charles VI of France expels all Jews from France.

1397

Jewish ghettos across Slovenia are set on fire by an anonymous mob.

1399

A Christian woman is accused of stealing hosts and giving them to Jews for the purpose of desecration. Thirteen members of the Jewish community of Posen, along with the woman are all tortured and burned alive slowly. The community is then forced to pay a special tax every year until the 18th century.

1399

80 Jews are murdered in Prague after a converted Jew named Peter accuses them of denigrating Christianity. A number of Jews are also jailed, including Yom-Tov Lipmann-Muhlhausen.

Fifteenth century

1401

Two Jews are burned to death for an alleged host desecration in Glogau.

1404

Many members of the Jewish community of Salzburg and Hallein is burned alive on charged of host desecration.

1407

Blood libel accusations against the Jews of Kraków led by a fanatic priest result in anti-Jewish riots.

1411

Oppressive legislation against Jews in Spain as an outcome of the preaching of the Dominican friar Vicente Ferrer.
Disputation of Tortosa, Spain, staged by the Avignon Pope Benedict XIII, is followed by forced mass conversions.

1418

All Jews living in Trier are expelled.

1420

All Jews are expelled from Lyons.

1421

Persecutions of Jews in Vienna, known as Wiener Gesera (Vienna Edict), confiscation of their possessions, and forced conversion of Jewish children. 270 Jews burned at stake.

1421

All Viennese Jews are expelled following persecution.

1422

Pope Martin V issues a Bull reminding Christians that Christianity was derived from Judaism and warns the friars not to incite against the Jews. The Bull was withdrawn the following year on allegations that the Jews of Rome attained it by fraud.

1424

The Jewish population of Zurich is exiled.

1424

Jews are expelled and banned from Cologne.

1426

Jews are expelled from Iglau after they are accused of being in league with the Hussites.

1427

All Jews living in Bern are expelled and their property is seized.

1428

Jews are expelled from Fribourg.

1430

Pogrom in Aix-en-Provence breaks out in which 9 Jews are killed, many more are injured and 74 are forcibly converted.
Council of Basel, Sessio XIX: Jews are forbidden to obtain academic degrees and to act as agents in the conclusion of contracts between Christians.

1435
Massacre and forced conversion of Majorcan Jews.

1435
Jews are expelled from Speyer "forever."

1436
Jews of Zurich are expelled.\(^{[100]}\)

1438
Jewish inhabitants of Augsburg and Düsseldorf are expelled.

1438
Establishment of mellahs (ghettos) in Morocco.

1442
Synagogues and other Jewish buildings are destroyed by a riot of Glogau.

1442
Jews are expelled from Upper Bavaria.

1444
Jewish population of Utrecht are expelled.

1447
Casimir IV renews all the rights of Jews of Poland and makes his charter one of the most liberal in Europe. He revokes it in 1454 at the insistence of Bishop Zbigniew.

1449
The Statute of Toledo introduces the rule of purity of blood discriminating Conversos. Pope Nicholas V condemns it.

1450
Louis IX, Duke of Bavaria expels all Jews who reject baptism.
Around 40 Jews in Breslau are burned at the stake on charges of host desecration, while the head Rabbi hung himself to avoid the torture. Jewish children under 7 were stolen and forcibly baptized. The few Jews remaining were banished from Breslau.

1456

Pope Calixtus III issues a papal bull which prohibits Jews from testifying against Christians, but permits Christians to testify against a Jew.

1458

The city council of Erfurt, Germany votes to expel the Jews.

1463

Pope Nicholas V authorizes the establishment of the Inquisition to investigate heresy among the Marranos. See also Crypto-Judaism.

1465

The Moroccan revolt against the Marinid dynasty, accusations against one Jewish Vizier lead to a massacre of the entire Jewish population of Fes.

1465

Over 30 Jews in Cracow are killed by an angry mob.

1468

Many Jewish homes and plundered and a number are killed during anti-Jewish in Posen.

1468

Sultan Qaitbay forces Jews of Cairo to pay 75,000 gold pieces or be expelled. This severely impoverished the local Jewish community.

1470

The Jewish community of Bavaria are expelled, many migrate into Bulgaria.

1473

Massacres of Marranos of Valladolid, Cordova, Segovia, Ciudad Real, Spain

1474

On Assumption day 15 August 1474, Christians wreaked brutal havoc on the Jewish dwellers of the Cartellone area of Modica. It was the first and most horrible massacre of Sicilian Jews. During the evening a number of Christians slaughtered about 360 Jews causing a total and fierce devastation in La Giudecca.
They ran through the streets chanting: "Hurrah for Mary! Death to the Jews!" (Viva Maria! Morte ai Giudei!).

1475

A student of the preacher Giovanni da Capistrano, Franciscan Bernardine of Feltre, accuses the Jews in murdering an infant, Simon. The entire community is arrested, 15 leaders are burned at the stake, the rest are expelled. In 1588, Pope Sixtus V confirmed Simon's cultus. Saint Simon was considered a martyr and patron of kidnap and torture victims for almost 500 years. In 1965, Pope Paul VI declared the episode a fraud, and decanonized Simon's sainthood.

1478

Jews of Passau are expelled.

1481

The Spanish Inquisition is instituted.

1484

Pogrom against the Jewish section of Arles. A number of Jews are killed and 50 men are forced to convert.

1487–1504

Bishop Gennady exposes the heresy of Zhidovstvuyushchiye (Judaizers) in Eastern Orthodoxy of Muscovy.

1490

Tomás de Torquemada burns 6,000 volumes of Jewish manuscripts in Salamanca.

1490

Jews are expelled from Geneva and not allowed to return for over 300 years.

1491

The blood libel in La Guardia, Spain, where the alleged victim Holy Child of La Guardia became revered as a saint.

1491

Muhammad al-Maghili orders the expulsion and murder of the Jewish community in Tlemcen.

1492

The Jewish population of Tuat is massacred in a pogrom inspired by the preacher al-Maghili.

1492
Ferdinand II and Isabella issue General Edict on the Expulsion of the Jews from Spain: approx. 200,000. Some return to the Land of Israel. As many localities and entire countries expel their Jewish citizens (after robbing them), and others deny them entrance, the legend of the Wandering Jew, a condemned harbinger of calamity, gains popularity.

1492

Jews of Mecklenburg, Germany are accused of stabbing a consecrated wafer. 27 Jews are burned, including two women. The spot is still called the Judenberg. All the Jews are expelled from the Duchy.

1492

Askia Mohammad I decrees that all Jews must convert to Islam, leave or be killed. Judaism becomes illegal in Mali. This was based on the advice of Muhammad al-Maghili. The region of Timbuktu had previously been tolerant of other religions before Askia got into power.

1493

John II of Portugal deports several hundred Jewish children to the colony of São Tomé, where most of them die.

1493

Expulsion from Sicily: approx. 37,000.

1494

16 Jews are burned at the stake after a blood libel in Trnava.

1494

After a fire destroys the Jewish quarter of Cracow, the Polish king Jan I Olbracht transfers the Jews to Kazimierz, which would become the first Polish ghetto. Jews were confined to the ghetto until 1868.

1495

Jews in Lithuania are expelled and their property is seized. They were allowed to return 8 years later.

1495

The Jews of Lecce are massacred and the Jewish quarter is burned to the ground.

1495

The French conquer Naples and persecute the local Jews.

1496

Jews living in Styria are expelled and all their property is confiscated.
Forced conversion and expulsion of Jews from Portugal. This included many who fled Spain four years earlier.

1497

Entire Jewish community of Graz is expelled.

1497

Manuel I of Portugal decrees that all Jews must convert or leave Portugal without their children.

1498

Prince Alexander of Lithuania forces most of the Jews to forfeit their property or convert. The main motivation is to cancel the debts the nobles owe to the Jews. Within a short time trade grinds to a halt and the Prince invites the Jews back in.

1498

French Jews are expelled from most of France.

1499

Jews of Nuremberg are expelled.

1499

Jews are banished from Verona. The Jews who were money lenders were replaced with Christian usurers who oppressed the poor so bad that the Jews were very shortly called to return.

1499

All New Christians are prohibited from leaving Portugal, even those who were forcibly baptized.

Sixteenth century

1501

French Jews living in Provence are expelled.

1504

Jews living in Pilsen are expelled on charges of host desecration.

1504

Several Jewish scholars are burned at the stake for proselytizing in Moscow.
Ten České Budějovice Jews are tortured and executed after being accused of killing a Christian girl; later, on his deathbed, a shepherd confesses to fabricating the accusation.

A marrano expresses his doubts about miracle visions at St. Dominics Church in Lisbon, Portugal. The crowd, led by Dominican friars, kills him, then ransacks Jewish houses and slaughters any Jew they could find. The countrymen hear about the massacre and join in. Over 2,000 marranos killed in three days.

A converted Jew Johannes Pfefferkorn receives authority of Maximilian I, Holy Roman Emperor to destroy the Talmud and other Jewish religious books, except the Hebrew Bible, in Frankfurt.

Forty Jews are executed in Brandenburg, Germany for allegedly desecrating the host; remainder expelled. 23 November. Less-wealthy Jews expelled from Naples; remainder heavily taxed. 38 Jews burned at the stake in Berlin.

Spanish gain control of Calabria and expel all Jews and New Christians.

Spain gains control of Naples and expels the Jewish population.

The officials of Conegliano try to expel the Jewish population but are unsuccessful.

Eight Roman Catholic converts from Judaism burned at the stake for allegedly reverting.

Most Apulian Jews are either expelled or are tortured to death. Jewish property is seized and Synagogues are replaced with Catholic Churches.

The Jewish population of Mittelberg is accused of host desecration.

Jews are expelled from Laibach.
Jews are expelled from the city of Genoa, but are allowed back in a year later.

1515

Emperor Maximillian expels Jews from Ljubljana.

1516

The first ghetto is established, on one of the islands in Venice.

1517

1517 Hebron attacks: Jews are beaten, raped and killed in Hebron, as their homes and businesses are looted and pillaged.

1517

1517 Safed attacks: The Jews of Safed is attacked by Mamluk forces and local Arabs. Many Jews are killed and their homes are plundered.

1519

The Jewish community of Ratisbon is expelled. The synagogue is destroyed and replaced with a chapel. Thousands of Jewish gravestones are taken and used for buildings.

1519

Martin Luther leads Protestant Reformation and challenges the doctrine of Servitus Judaeorum "... to deal kindly with the Jews and to instruct them to come over to us". 21 February. All Jews expelled from Ratisbon/Regensburg.

1520

Pope Leo X allows the Jews to print the Talmud in Venice.

1523

The conquest of Cranganore by the Portuguese leads to the complete destruction of the local Jewish community. Most refugees fled to Cochin.

1523

Mexico bans immigration from those who can't prove four generations of Catholic ancestry.

1526

Jews are expelled from Hungary, Croatia, and Slovakia following the Battle of Mohács.

1527

Jews are ordered to leave Florence, but the edict is soon rescinded.
Three judaizers are burned at the stake in Mexico City's first auto da fé.

30 Jewish men, women, and children are burned at the stake in Pezinok.

Solomon Molcho is burned at the stake for refusing to return to Catholicism after reverting to Judaism.

After Spanish troops capture Tunis all the local Jews are sold into slavery.

Jews are expelled from Nauheim.

Katarzyna Weiglowa, a Roman Catholic woman from the Kingdom of Poland who converted to Judaism is burned at the stake in Kraków under the charge of apostasy for refusing to call Jesus Christ the Son of God. She is regarded by Jews (among others) as a martyr.

All Jews are banished from Prague.

Moses Fishel of Cracow is accused of proselytizing and dies a martyr.

Jews are exiled from Basel.

Jeronimo Diaz, a New Christian physician, is burned at the stake for holding heretical opinions in Goa, India.

In his pamphlet On the Jews and Their Lies Martin Luther advocates an eight-point plan to get rid of the Jews as a distinct group either by religious conversion or by expulsion:

"...set fire to their synagogues or schools..."
"...their houses also be razed and destroyed..."

"...their prayer books and Talmudic writings... be taken from them..."

"...their rabbis be forbidden to teach henceforth on pain of loss of life and limb..."

"...safe-conduct on the highways be abolished completely for the Jews..."

"...usury be prohibited to them, and that all cash and treasure of silver and gold be taken from them..." and

"Such money should now be used in ... the following [way]... Whenever a Jew is sincerely converted, he should be handed [certain amount]..."

"...young, strong Jews and Jewesses [should]... earn their bread in the sweat of their brow..."

"If we wish to wash our hands of the Jews' blasphemy and not share in their guilt, we have to part company with them. They must be driven from our country" and "we must drive them out like mad dogs."

Luther "got the Jews expelled from Saxony in 1537, and in the 1540s he drove them from many German towns; he tried unsuccessfully to get the elector to expel them from Brandenburg in 1543. His followers continued to agitate against the Jews there: they sacked the Berlin synagogue in 1572 and the following year finally got their way, the Jews being banned from the entire country."

1546

Martin Luther's sermon Admonition against the Jews contains accusations of ritual murder, black magic, and poisoning of wells. Luther recognizes no obligation to protect the Jews.

1547

Ivan the Terrible becomes ruler of Russia and refuses to allow Jews to live in or even enter his kingdom because they "bring about great evil" (quoting his response to request by Polish king Sigismund II).

1547

10 out of the 30 Jews living in Asolo are killed and their houses are robbed.

1550

Dr. Joseph Hacohen is chased out of Genoa for practicing medicine; soon all Jews are expelled.

1553

Pope Julius III forbids Talmud printing and orders burning of any copy found. Rome's Inquisitor-General, Cardinal Carafa (later Pope Paul IV) has Talmud publicly burnt in Rome on Rosh Hashanah, starting a wave of Talmud burning throughout Italy. About 12,000 copies were destroyed.
1554

Cornelio da Montalcino, a Franciscan Friar who converted to Judaism, is burned alive in Rome.

1555

In Papal Bull Cum nimis absurdum, Pope Paul IV writes: "It appears utterly absurd and impermissible that the Jews, whom God has condemned to eternal slavery for their guilt, should enjoy our Christian love." He renews anti-Jewish legislation and installs a locked nightly ghetto in Rome. The Bull also forces Jewish males to wear a yellow hat, females – yellow kerchief. Owning real estate or practicing medicine on Christians is forbidden. It also limits Jewish communities to only one synagogue.

1555

The Martyrs of 1555. 25 Jews in Ancona are hung or burned at the stake for refusing to convert to Christianity as a result of Pope Paul IV's Bull of 1555.

1556

A rumor is sent around that a poor woman in Sokhachev named Dorothy sold Jews the holy wafer received by her during communion, and that it was stabbed until it bled. The Bishop of Khelm accuses the local Jews, and eventually three Jews along with Dorothy Lazhentzka are arrested, put on the rack, and sentenced to death on charges of host desecration. They were burned at the stake. Before their death, the martyred Jews made a declaration:

"We have never stabbed the host, because we do not believe that the host is the Divine body, knowing that God has no body nor blood. We believe, as did our forefathers, that the Messiah is not God, but His messenger. We also know from experience that there can be no blood in flour."

1557

Jews are temporarily banished from Prague.

1558

Recanati, Italy: a baptized Jew Joseph Paul More enters synagogue on Yom Kippur under the protection of Pope Paul IV and tries to preach a conversion sermon. The congregation evicts him. Soon after, the Jews are expelled from Recanati.

1559

Pope Pius IV allows Talmud on conditions that it is printed by a Christian and the text is censored.

1560

The Goa Inquisition begins.
Ferdinand I takes an oath to expel the Jews. Mordechai Zemach runs to Rome and convinces Pope Pius IV to cancel the decree.

1563

Russian troops take Polotsk from Lithuania. Jews are given ultimatum: embrace Russian Orthodox Church or die. Around 300 Jewish men, women and children were thrown into ice holes of Dvina river.

1564

Brest-Litovsk: the son of a wealthy Jewish tax collector is accused of killing the family's Christian servant for ritual purposes. He is tortured and executed in line with the law. King Sigismund II of Poland forbids future charges of ritual murder, calling them groundless.

1565

Jews are temporarily banished from Prague.

1566

Antonio Ghislieri elected and, as Pope Pius V, reinstates the harsh anti-Jewish laws of Pope Paul IV. In 1569 he expels Jews dwelling outside of the ghettos of Rome, Ancona, and Avignon from the Papal States, thus ensuring that they remain city-dwellers.

1567

Jews are allowed to live in France.

1569

Pope Pius V expels all the Jews of Bologna. He then gave their cemetery away and commended all Jewish gravestones to be destroyed.

1569

Pope Pius V issues the Bull Hebraeorum gens sola which orders the expulsion of all Jews who refuse to convert.

1571

Jews in Berlin are forced to leave and their property is confiscated.

1571

The Mexican Inquisition begins.

1574

First auto-da-fé in Mexico.

1581
Pope Gregory XIII issues a Bull which prohibits the use of Jewish doctors.

1583
Three Portuguese conversos are burned at the stake in Rome.

1586
Pope Sixtus V forbids printing of the Talmud.

1590
Jewish quarter of Mikulov (Nikolsburg) burns to ground and 15 people die while Christians watch or pillage. King Philip II of Spain orders expulsion of Jews from Lombardy. His order is ignored by local authorities until 1597, when 72 Jewish families are forced into exile.

1591
Philip II, King of Spain, banished all Jews from the duchy of Milan.

1592
Esther Chiera is executed with one of her sons by the Sultan Murad III's calvary.

1593
Pope Clement VIII confirms the Papal bull of Paul III that expels Jews from Papal states except ghettos in Rome and Ancona and issues Caeca et obdurata ("Blind Obstinacy"): "All the world suffers from the usury of the Jews, their monopolies and deceit. ... Then as now Jews have to be reminded intermittently anew that they were enjoying rights in any country since they left Palestine and the Arabian desert, and subsequently their ethical and moral doctrines as well as their deeds rightly deserve to be exposed to criticism in whatever country they happen to live."

1593
At least 900 are expelled from Bologna.

1595
10 people are accused of practicing Judaism in Lima, Peru. Four of them are released and one named Francisco Rodríguez, is burned alive.

1596
Francisca Nuñez de Carabajal was a Marrana (Jewish convert to Christianity) in New Spain executed by the Inquisition for "judaizing" in 1596. One of her children, Isabel, in her twenties at the time, was tortured until she implicated the whole of the Carabajal family. The whole family was forced to confess and abjure at a public auto-da-fé, celebrated on Saturday, 24 February 1590. Luis de Carabajal the younger (one of Francisca's sons), along with Francisca and four of her daughters, was condemned to perpetual
imprisonment, and another one of Francisca's sons, Baltasar, who had fled upon the first warning of danger, was, along with his deceased father Francisco Rodriguez de Matos, burnt in effigy. In January 1595, Francisca and her children were accused of a relapse into Judaism and convicted. During their imprisonment they were tempted to communicate with one another on Spanish pear seeds, on which they wrote touching messages of encouragement to remain true to their faith. At the resulting auto-da-fé, Francisca and her children Isabel, Catalina, Leonor, and Luis, died at the stake, together with Manuel Diaz, Beatriz Enriquez, Diego Enriquez, and Manuel de Lucena. Of her other children, Mariana, who lost her reason for a time, was tried and put to death at an auto-da-fé held in Mexico City on 25 March 1601; Anica, the youngest child, being "reconciled" at the same time.

1598
3 Jews in Lublin are brutally tortured and executed by quartering, after a Christian boy is found in a nearby swamp.

Seventeenth century

1600
14 Judaizers are punished in Lima, Peru.

1603
Frei Diogo da Assumpção, a partly Jewish friar who embraced Judaism, burned alive in Lisbon.

1605
16 Judaizers are arrested in Lima, Peru.

1608
The Jesuit order forbids admission to anyone descended from Jews to the fifth generation, a restriction lifted in the 20th century. Three years later Pope Paul V applies the rule throughout the Church, but his successor revokes it.

1612
The Hamburg Senate decides to officially allow Jews to live in Hamburg on the condition there is no public worship.

1614
Vincent Fettmilch, who called himself the "new Haman of the Jews", leads a raid on Frankfurt synagogue that turned into an attack which destroyed the whole community.
1615
King Louis XIII of France decrees that all Jews must leave the country within one month on pain of death.

1615
The Guild led by Dr. Chemnitz, “non-violently” forced the Jews from Worms.

1616
Jesuits arrive in Grodno and accuse the Jews of host desecration and blood libel.

1618
Anti-semitic pamphlet Mirror of the Polish Crown is published by professor Sebastian Miczyński. It accuses the Jews of murder, sacrileges, witchcraft, and urges their expulsion. It would go on to inspire anti-Jewish riots across Poland.

1619
Shah Abbasi of the Persian Sufi Dynasty increases persecution against the Jews, forcing many to outwardly practice Islam. Many keep practicing Judaism in secret.

1622
King Christian IV invites Jews to come and live in Denmark.

1624
Ghetto established in Ferrara, Italy.

1624
Christian theologian Antonio Homem is burned at the stake for pursuing Judaism.

1625
Jews of Vienna forced to live in a ghetto in Leopoldstadt.

1628
Roman Jewish mistress of the son of the duke of Parma is burned alive.

1630
Jewish merchant Moses the Braider is burned alive after being accused of host desecration.

1631
Due to awful conditions in the Jewish Ghetto of Padua, 421 out of the 721 Jews living in the ghetto perish.

1632
King Ladislaus IV of Poland forbids antisemitic books and printings.
1632
Shortly after Miguel Rodriguez is discovered holding onto Jewish rites, an Auto-da-fé is held in the presence of the King and Queen. Miguel and his wife Isabel Alvarez, and 5 others are burned alive publicly.

1632, 20 April
Jewish-convert and martyr Nicolas Antoine is burned at the stake for heresy.

1633
Jews are banned from Radom.

1635
Anti-Jewish riots take place in Vilna.

1637
Four Jews are publicly tortured and executed in Kraków.

1639
Over 60 Judaizers are burned at the stake at an Auto-da-fé in Lima, Peru. Among those martyred was physician Francisco Maldonado de Silva.

1639
Two Roman Jewish children are forcibly baptized by Pope Urban VIII.

1639
Jews of Lenchitza are accused of ritual murder after a young child is found dead in the woods. The blame falls on the Jews after a local gentile named Foma confesses to the crime then says he had been coerced into doing it by the Jews. Despite the lack of evidence, two Jewish elders named Meyer and Lazar are arrested and tortured, and eventually quartered publicly.

1644
Jewish martyr Judah the Believer is burned at the stake as he recites prayers in Hebrew.

1647
Jewish martyr Isaac de Castro Tartas is burned at the stake while he recites the Shema along with 6 other Jews.

1648–1655
The Ukrainian Cossacks led by Bohdan Chmielnicki massacre about 100,000 Jews and similar number of Polish nobles, 300 Jewish communities destroyed.
1649

Largest Auto-da-fé in the New World. 109 victims, 13 were burned alive and 57 in effigy.

1655

Oliver Cromwell readmits Jews to England.

1656

All Jews are expelled from Isfahan because of the common belief of their impurity. The ones who don't are forced to convert to Islam.

1657–1662

Jews throughout Iran (including 7,000 in Kashan alone) are forced to convert to Islam as a result of persecutions by Abbas II of Persia.

1661

Sephardic poet Antonio Enríquez Gómez is publicly burned in effigy in Seville.

1663

Two Christian Janissaries accuse the Jews of Istanbul of killing a child who had actually been killed by his own father. After killing his own son, he threw his body onto the Jewish quarter in order to implicate the Jews in the crime. Once the Grand Vizier learned the facts of the case from his spies stationed in the Greek quarter, he informed the Sultan and the Janissaries were put to death. 20 Jews were killed in total by the Greek mobs.

1664 May

Jews of Lemberg (now Lvov) ghetto organize self-defense against impending assault by students of Jesuit seminary and Cathedral school. The militia sent by the officials to restore order, instead joined the attackers. About 100 Jews killed.

1669

The majority of Jews in Oran are expelled.

1670

Jews expelled from Vienna.

1670

Raphael Levy is burned at the stake over blood libel. After being offered a chance to convert and live, he declared that he had lived a Jew and would die a Jew.
The **Exile of Mawza**. It is considered the single most traumatic event experienced collectively by the Jews of Yemen. All Jews living in nearly all cities and towns throughout Yemen were banished by decree of the king, Imām al-Mahdi Ahmad, and sent to a dry and barren region of the country named Mawza to withstand their fate or to die. Only a few communities who lived in the far eastern quarters of Yemen were spared this fate by virtue of their Arab patrons who refused to obey the King's orders. Many would die along the route and while confined to the hot and arid conditions of this forbidding terrain.

1680

**Auto-da-fé in Madrid.**

1681

Mob attacks against Jews in **Vilna**. It was condemned by King John Sobieski, who ordered the punishment of the guilty.

1682

Largest trial against alleged Judaizers in **Lisbon**, Portugal. 117 were tried in 3 days.

1683

Hungarian rebels known as **Kuruc** rushes into the town of **Uherský Brod**, massacring the majority of its Jewish inhabitants. Most of the victims were recent refugees who were expelled from Vienna in 1670. One of the Hebrews killed by the mob was Jewish historian **Nathan ben Moses Hannover**, who was a survivor of the Chmielnicki massacres. Most of the survivors fled to Upper Hungary.

1684

Attack on the Jewish ghetto of **Buda**.

1686

Only 500 Jews survive after Austrian sieged the city of **Buda**. Half of them are sold into slavery.

1689

**Worms** is invaded by the French and the Jewish quarter is reduced to ashes.

1689

The Jewish Ghetto of **Prague** is destroyed by French troops. After it was over 318 houses, 11 synagogues, and 150 Jews were dead.

1691

219 people are convicted of being Jewish in **Palma, Majorca**. 37 of them are burned to death. Among those martyred is Raphael and his sister Catalina Benito, who although declaring she wanted to live, jumped right into the flames rather than to be baptized.
1696
A number of Converso Jews are burned alive in Évora, Portugal.

1698
A female child is found dead at a church in Sandomierz. The mother of the child first said she placed her body in the church because she could not afford a burial, but after torture accused the Jewish leader Aaron Berek of the local community of murdering her daughter. The mother and Berek were sentenced the death.

1699
A mob attacks the Jewish Quarter of Bamberg but runs away after one Jew stops them by pouring baskets of ripe plums on the attackers. The event is still commemorated on the 29th of Nisan as the Zwetschgen-Ta’anit (Prune-Fest).

Eighteenth century

1703
The Aleinu prayer is prohibited in most of Germany.

1706
After a plague hits Algeria which pushes the Jewish community into poverty, the local ruler decides the plague was caused by the Jews and orders their expulsion. Property is confiscated, synagogues are destroyed, until a sum is paid which further impoverishes the Jews of Algiers.

1711
Johann Andreas Eisenmenger writes his Entdecktes Judenthum (“Judaism Unmasked”), a work denouncing Judaism and which had a formative influence on modern antisemitic polemics.

1712
Blood libel in Sandomierz and expulsion of the town's Jews.

1715
Elector Max Emanuel orders the deportation of all Jews living in Bavaria.

1717
All Jews living in Gibraltar are expelled.

1718
The last Jews of Carniola, Styria and Carinthia are expelled.

1720
Arab creditors set fire to an Ashkenazi synagogue, fed up with debts. Ashkenazic Jews are banned from Jerusalem along with anyone who looks like an Ashkenazi Jew. Some Ashkenazim dressed up like Sephardic Jews in order to fool the authorities.

1721

Maria Barbara Carillo was burned at the stake for heresy during the Spanish Inquisition. She was executed at the age of 95 or 96 and is the oldest person known to have been executed at the instigation of the Inquisition. Carillo was sentenced to death for heresy for returning to her faith in Judaism.

1724

Jews of Radom are exiled.

1727

Edict of Catherine I of Russia: "The Jews... who are found in Ukraine and in other Russian provinces are to be expelled at once beyond the frontiers of Russia."

1734

1736: The Haidamaks, paramilitary bands in Polish Ukraine, attack Jews.

1736

Maria Francisca Ana de Castro, called La bella toledana, a Spanish immigrant to Peru, was arrested in 1726, accused of "judaizing" (being a practicing Jew). She was burned at the stake after an auto de fe in 1736. This event was a major spectacle in Lima, but it raised questions about possible irregular procedures and corruption within the Inquisition.

1737

Blood libel in Jaroslaw leads to Jews being tortured and others being put to death.

1742

Elizabeth of Russia issues a decree of expulsion of all the Jews out of Russian Empire. Her resolution to the Senate's appeal regarding harm to the trade: "I don't desire any profits from the enemies of Christ". One of the deportees is Antonio Ribera Sanchez, her own personal physician and the head of army's medical dept.

1743

The Russians gain control of Riga and all local Jews are expelled.

1744

Frederick II The Great (a "heroic genius", according to Hitler) limits Breslau to ten "protected" Jewish families, on the grounds that otherwise they will "transform it into complete Jerusalem". He encourages this practice in other Prussian cities. In 1750 he issues Revidiertes General Privilegium und Reglement vor die
Judenschaft: "protected" Jews had an alternative to "either abstain from marriage or leave Berlin" (Simon Dubnow).

1744

Archduchess of Austria Maria Theresa orders: "... no Jew is to be tolerated in our inherited duchy of Bohemia" by the end of Feb. 1745. In December 1748 she reverses her position, on condition that Jews pay for readmission every ten years. This extortion was known as malke-geld (queen's money). In 1752 she introduces the law limiting each Jewish family to one son.

1746

The city of Radom bans Jews from entering.

1753

The Jewish community of Kaunas is expelled.

1755

Jeronimo Jose Ramos, a merchant from Bragança, Portugal, is burned at the stake for being secretly Jewish.

1761

Several Jews from Alsace are executed after being accused of host desecration.

1761

The Jews of Kaunas are expelled after anti-Jewish riots.

1762

Rhode Island refuses to grant Jews citizenship stating "no person who is not of the Christian religion can be admitted free to this colony."

1766

All but 6 Jews are expelled from Toruń.

1768

Haidamaks massacre the Jews of Uman, Ukraine.

1775

Pope Pius VI issues a severe Editto sopra gli ebrei (Edict concerning the Jews). Previously lifted restrictions are reimposed, Judaism is suppressed.

1776

The Jewish community of Basra is massacred.
1782

Holy Roman Emperor Joseph II abolishes most of persecution practices in Toleranzpatent on condition that Yiddish and Hebrew are eliminated from public records and judicial autonomy is annulled. Judaism is branded "quintessence of foolishness and nonsense". Moses Mendelssohn writes: "Such a tolerance... is even more dangerous play in tolerance than open persecution".

1783

The Sultan expels the Moroccan Jews for failing to pay an exorbitant ransom.

1785

Ali Burzi Pasha murders hundreds of Libyan Jews.

1786

Jews are expelled from Jeddah, most of them flee to Yemen.

1790

Yazid becomes the Sultan of Morocco and immediately orders troops to massacre and plunder the Jewish quarter of Tétouan.

1790

The Touro Synagogue's warden, Moses Seixas, wrote to George Washington, expressing his support for Washington's administration and good wishes for him. Washington sent a letter in response, which read in part:

"... the Government of the United States ... gives to bigotry no sanction, to persecution no assistance. ... May the children of the Stock of Abraham, who dwell in this land, continue to merit and enjoy the good will of the other Inhabitants; while every one shall sit in safety under his own vine and figtree, and there shall be none to make him afraid. May the father of all mercies scatter light and not darkness in our paths, and make us all in our several vocations useful here, and in his own due time and way everlastingly happy."

— Letter of George Washington to the Hebrew Congregation in Newport, Rhode Island

There is an annual event reading Washington's letter, and speakers at the annual event have included Supreme Court Justices Ruth Bader Ginsburg and Elena Kagan; and Brown University Presidents Ruth Simmons and Christina Paxson.

1790, 20 May

Eleazer Solomon is quartered for the alleged murder of a Christian girl in Grodno.

1790–1792
Destruction of most of the Jewish communities of Morocco.

1791
Catherine II of Russia confines Jews to the Pale of Settlement and imposes them with double taxes.

1797
Napoleon calls for the end of Jewish segregation, ghettoization and the denial of equal rights.

Nineteenth century

1800s

1805, June 29

200-500 Algerian Jews are massacred.

1810s

1811
Head of the Jewish community of Algiers David ben Joseph Coen Bakri is decapitated by the Dey Hadj Ali.

1815
Eight Jews are burned at the stake in Algiers.

1815
Pope Pius VII reestablishes the ghetto in Rome after the defeat of Napoleon.

1818
Turks from Algiers attack Constantine, massacre and pillage Jewish homes, and abduct 17 young Jewish girls whom they bring to their commander.

1819
A series of anti-Jewish riots in Germany that spread to several neighboring countries: Denmark, Latvia and Bohemia known as Hep-Hep riots, from the derogatory rallying cry against the Jews in Germany.
1820s

1827

Compulsory military service for the Jews of Russia: Jewish boys under 18 years of age, known as the Cantonists, were placed in preparatory military training establishments for 25 years. Cantonists were encouraged and sometimes forced to baptize.

1829

The law in Canada requiring the oath "on my faith as a Christian" was amended in 1829 to provide for Jews to not take the oath.

1830s

1830

The Persian Jewish population of Tabriz, Iran is attacked by a mob, resulting in most of the Jewish community either being killed or fleeing.

1830

The Jews of Shiraz are forced to convert to Islam.

1831

The prominent French-Canadian politician Louis-Joseph Papineau sponsored a law which granted full equivalent political rights to Jews in Lower Canada, twenty-seven years before anywhere else in the British Empire.

1832

Partly because of the work of Ezekiel Hart, a law was passed that guaranteed Jews the same political rights and freedoms as Christians in Canada.

1833

Clemens Brentano published The Dolorous Passion of Our Lord Jesus Christ According to the Meditations of Anne Catherine Emmerich. The "Dolorous Passion" is claimed to reveal a "clear antisemitic strain throughout", with Brentano writing that Emmerich believed that "Jews ... strangled Christian children and used their blood for all sorts of suspicious and diabolical practices."

1834

The 1834 looting of Safed was a month-long attack on the Jewish population of Safed by local Arab and Druze villagers. It was full of large scale looting, as well as the killing and raping of Jews and the
destruction of many homes and synagogues. Before the attacks Jews made up over 50% of the population, but a lot of them fled to nearby cities which reduced their presence drastically.

1834

Jewish heroine and martyr Sol Hachuel is publicly decapitated at 17 years old in Fez, Morocco. She is executed for refusing to convert to Islam.

1835

Oppressive constitution for the Jews issued by Czar Nicholas I of Russia.

1838

The 1838 Druze attack on Safed was a plunder of the Jewish community of Safed by the local Druze during the Druze revolt.

1839

40+ Persian Jews are killed and the entire Jewish community of Mashhad is forced to convert to Islam in the Allahdad. A lot of them practiced Judaism in secret, which led to the Mashhadi Jews, whom today number in the thousands.

1840s

1840

The Damascus affair: false accusations cause arrests and atrocities, culminating in the seizure of sixty-three Jewish children and attacks on Jewish communities throughout the Middle East.

1844

Karl Marx praises Bruno Bauer's essays containing demands that the Jews abandon Judaism, and publishes his work On the Jewish Question: "What is the worldly cult of the Jew? Huckstering. What is his worldly god? Money... Money is the jealous God of Israel, besides which no other god may exist... The god of the Jews has been secularized and has become the god of this world", "In the final analysis, the emancipation of the Jews is the emancipation of mankind from Judaism." This probably led to the antisemitic feeling within communism.

1850s

1850

Das Judenthum in der Musik (German for "Jewishness in Music", but normally translated Judaism in Music; spelled after its first publications, according to modern German spelling practice, as ‘Judentum’), is
an essay by Richard Wagner which attacks Jews in general and the composers Giacomo Meyerbeer and Felix Mendelssohn in particular. It was published under a pseudonym in the Neue Zeitschrift für Musik (NZM) of Leipzig in September 1850 and was reissued in a greatly expanded version under Wagner's name in 1869. It is regarded by some as an important landmark in the history of German antisemitism.

1853

Blood libels in Saratov and throughout Russia.

1858

Edgardo Mortara, a six-year-old Jewish boy whom a maid had baptised during an illness, is taken from his parents in Bologna, an episode which aroused universal indignation in liberal circles.

1860s

1860

The Jews of Hamadan are accused of mocking the Ta'zieh ceremonies for Imam Husain, several of them are fined and some have their ears and noses cut off as punishment. [6]

1862

During the American Civil War General Grant issues General Order № 11 (1862), ordering all Jews out of his military district, suspecting them of pro-Confederate sympathy. President Lincoln directs him to rescind the order. Polish Jews are given equal rights. Old privileges forbidding Jews to settle in some Polish cities are abolished.

1863

A Jew in Hamadan is lynched by a Muslim mob, and many others are severely injured after being accused of insulting the Prophet Mohammad.

1864

At least 500 Moroccan Jews are massacred in Marrakech and Fez.

1866

The Jews of Barforush are forcibly converted to Islam. When they are allowed to revert to Judaism thanks to French and British ambassadors, a Muslim mob kills 18 Jews, burning two of them alive.

1868

Samuel Bierfield [?–15 August 1868] is believed to be the first Jew lynched in the United States. Bierfield and his African-American clerk, Lawrence Bowman, were apprehended in Bierfield's store in Franklin.
Tennessee and fatally shot by a group of masked men believed to belong to the Ku Klux Klan, on 15 August 1868. No one was ever convicted of the crime, however.

1869

18 Tunisian Jews are killed in a pogrom and an Arab mob loots Jewish homes and stores, burns synagogues, on Jerba Island.

1870s

1870

The 35,000 Jews living in Algeria are granted French citizenship as a result of the Crémieux Decree. This leads to a rise of anti-Semitism in Algeria and across the Middle East.

1871

Speech of Pope Pius IX in regard to Jews: "of these dogs, there are too many of them at present in Rome, and we hear them howling in the streets, and they are disturbing us in all places."

1873

The Southern Baptist Convention passed a "Resolution On Anti-Semitism" stating, "RESOLVED, That we do gratefully remember this day our unspeakable indebtedness to the seed of Abraham, and devoutly recognize their peculiar claims upon the sympathies and prayers of all Gentile Christians, and we hereby record our earnest desire to partake in the glorious work of hastening the day when the superscription of the Cross shall be the confession of all Israel 'Jesus of Nazareth, the King of the Jews'."

1875

20 Jews are killed by a Muslim mob in Demnat, Morocco.

1878

Adolf Stoecker, German antisemitic preacher and politician, founds the Christian Social Party, which marks the beginning of the political antisemitic movement in Germany.

1879

9 Jews in Kutaisi are accused of ritual murder, and eventually are tried and found not guilty.

1879

Heinrich von Treitschke, German historian and politician, justifies the antisemitic campaigns in Germany, bringing antisemitism into learned circles.
Wilhelm Marr coins the term Anti-Semitism to distinguish himself from religious Anti-Judaism.

1880s

1881

Pogrom against the Jews in Tlemcen, Algeria.

1881

The German Reichstag receives and rejects a petition with more than 250,000 signatures, and supported by the Kaiser's personal chaplain, Adolf Stoecker, calling for the removal of Jews from public life.

1881

Georg Ritter von Schönerer, a pan-German Austrian leader and anti-Semite styles himself as "Führer" and he and his followers use the greeting "Heil!"

1881–1884

Pogroms sweep southern Russia, propelling mass Jewish emigration from the Pale of Settlement: about 2 million Russian Jews emigrated in period 1880–1924, many of them to the United States (until the National Origins Quota of 1924 and Immigration Act of 1924 largely halted immigration to the U.S. from Eastern Europe and Russia). The Russian word "pogrom" becomes international.

1882

Jewish population of Algiers is attacked by a Muslim mob.

1882

The Tiszaeszlár blood libel in Hungary arouses public opinion throughout Europe.

1882

The International Anti-Jewish Congress, led by Adolph Stoecker, convenes at Dresden, Germany; it appeals to "the Government and Peoples of Christian Nations Threatened by Judaism" to expel "the Semitic race of Jews" from Europe.

1882

A series of "temporary laws" by Tsar Alexander III of Russia (the May Laws), which adopted a systematic policy of discrimination, with the object of removing the Jews from their economic and public positions, in order to "cause one-third of the Jews to emigrate, one-third to accept baptism and one-third to starve" (according to a remark attributed to Konstantin Pobedonostsev).

1887
Russia introduces measures to limit Jews access to education, known as the quota.

1891

Blood libel in Xanten, Germany.

1890s

1891

Expulsion of 20,000 Jews from Moscow, Russia. The Congress of the United States eases immigration restrictions for Jews from the Russian Empire. (Webster-Campster report)

1891

Leading Muslims in Jerusalem asked the Ottoman authorities in Constantinople to prohibit the entry of Jews arriving from Russia.

1892

Mulla Abdullah issues a fatwa to kill all the Jews of Hamadan if they refuse to abide by Jewish restrictions. The local Persian Jews were later ordered to become Muslims or face death.

1892

Two Persian Jews go out to sell merchandise and end up killed with all of their property stolen. Their relatives went out to search for the bodies and when they found them, they were killed by the same villagers. Even after many attempts to plea for their, the governor of Savojbolagh County paid them no mind.

1892

Justinas Bonaventure Pranaitis writes The Talmud Unmasked an antisemitic and misleading inaccurate anti-Talmudic work.

1893

Karl Lueger establishes antisemitic Christian Social Party and becomes the Mayor of Vienna in 1897.

1894

The Dreyfus Affair in France. In 1898 Émile Zola publishes open letter J'accuse!

1895

A. C. Cuza organizes the Alliance Anti-semitique Universelle in Bucharest, Romania.
1895
Captain Alfred Dreyfus being dishonorably discharged in France.

1897
Synagogues and Jewish homes are pillaged in Oran.

1897
Synagogues are ransacked and Jews are murdered in Tripolitania.

1898
Violent anti-Jewish riots erupt in Algiers.

1899
Houston Stewart Chamberlain, racist and antisemitic author, publishes his Die Grundlagen des 19 Jahrhunderts which later became a basis of National-Socialist ideology.; 1899: Blood libel in Bohemia (the Hilsner case).

Twentieth century

1900s

1903
The Kishinev pogrom: 49 Jews murdered.

1903
The first publication of The Protocols of the Elders of Zion hoax in St. Petersburg, Russia (by Pavel Krushevan).

1904
The Limerick boycott was an economic boycott waged against the small Jewish community in Limerick, Ireland. It was accompanied by a number of assaults, stone throwing and intimidation, which caused many Jews to leave the city.

1905
Pogrom in Yekaterinoslay. 66 Jews were killed and 125 wounded and Jewish homes and shops were looted.
1905

The **1905 Kiev pogrom** was a massacre of 100 Jews.

1906

**Alfred Dreyfus** was exonerated and reinstated as a major in the French Army.

1907

Over 60 Jews in the **Mellah of Casablanca** are killed in a pogrom by Kabyle Muslims. Many more were wounded, and a large number of women and children were carried off.

1909

**Salomon Reinach** and **Florence Simmonds** refer to "this new antisemitism, masquerading as patriotism, which was first propagated at Berlin by the court chaplain Stöcker, with the connivance of Bismarck." Similarly, Peter N. Stearns comments that "the ideology behind the new anti-Semitism [in Germany] was more racist than religious."

1910s

1910

The **1910 Shiraz blood libel** was a pogrom of the Jewish quarter in Shiraz, Iran. It was sparked by accusations that the Jews had **ritually murdered a Muslim girl**. By the end of the pogrom, 12 Jews were killed, 50 or so were wounded, and 6,000 were robbed of all their possessions.

1912

The **Tritl, or the 1912 Fez massacre** left 42 Moroccan Jews dead.

1913

The **Blood libel trial of Menahem Mendel Beilis** in Kiev.

1915

In one 48-hour interval in May 1915, all 40,000 Jews living in **Kaunas, Lithuania** are forcibly removed from the city.

1915

The **Leo Frank trial and lynching** in Atlanta, Georgia turns the spotlight on antisemitism in the United States and leads to the founding of the **Anti-Defamation League**.

1917–1921
Attacked for being revolutionaries or counter-revolutionaries, unpatriotic pacifists or warmongers, religious zealots or godless atheists, capitalist exploiters or bourgeois profiteers, masses of Jewish civilians (by various estimates 70,000 to 250,000, the number of orphans exceeded 300,000) were murdered in pogroms in the course of Russian Civil War.

1918

3,000–10,000 Mountain Jews are killed during March Days.

1918

The Lwów pogrom of 1918 was an attack on the Jewish population of Lwów that took place on 21–23 November 1918 during the Polish–Ukrainian War. After the pogrom was over, an estimated 52–150 Jewish residents were killed and hundreds were injured.

1919

The Kiev pogroms of 1919 were a series of pogroms in various places around Kiev carried out by White Volunteer Army troops. There were a total of 1,326 pogroms across Ukraine around that time, in which between 30,000 and 70,000 Jews were massacred. According to some estimates, the pogroms left half a million Jews homeless. The series of events occurred in the following districts:

1919

The Pinsk massacre was the mass execution of thirty-five Jewish residents of Pinsk on 5 April 1919 by the Polish Army.

1919

In February 1919 a brigade of UNR troops killed 1500 Jews in Proskurov.

1919

In Tetiev on 25 March 1919, Cossack troops under the command of Colonels Cherkovsky, Kurovsky and Shliatoshenko murdered 4,000 Jews.

1919–1920

During the Russian Civil War the Jews of Uman in eastern Podolia were subjected to two pogroms in 1919, as the town changed hands several times. The first pogrom, in spring, claimed 170 victims; the second one, in summer, more than 90. This time the Christian inhabitants helped to hide the Jews. The Council for Public Peace, with a Christian majority and a Jewish minority, saved the city from danger several times. In 1920, for example, it stopped the pogrom initiated by the troops of General Denikin.

1919–1922

Soviet Yevsektsiya (the Jewish section of the Communist Party) attacks Bund and Zionist parties for "Jewish cultural particularism". In April 1920, the All-Russian Zionist Congress is broken up by Cheka led
by Bolsheviks, whose leadership and ranks included many anti-Jewish Jews. Thousands are arrested and sent to Gulag for "counter-revolutionary... collusion in the interests of Anglo-French bourgeoisie... to restore the Palestine state." Hebrew language is banned, Judaism is suppressed, along with other religions.

1920s

1920

The Jerusalem pogrom of April 1920 of old Yishuv.

1920

The idea that the Bolshevik revolution was a Jewish conspiracy for the world domination sparks worldwide interest in The Protocols of the Elders of Zion. In a single year, five editions are sold out in England alone. In the US Henry Ford prints 500,000 copies.

1920

In the Spring of 1920, Henry Ford made his personal newspaper, The Dearborn Independent, chronicle what he considered the "Jewish menace". Every week for 91 issues, the paper exposed some sort of Jewish-inspired evil major story in a headline. The most popular and aggressive stories were then chosen to be reprinted into four volumes called The International Jew.

1921

All Jews in Mongolia are expelled by Russian anti-Bolshevik forces retreating after being defeated in Central Asia.

1921

Jaffa riots in Palestine.

1921–1925

Outbreak of antisemitism in United States, led by Ku Klux Klan.

1922

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1923
Der Stürmer (pronounced [deːɐ̯ ˈʃtʏʁma], lit. "the Attacker") was a weekly tabloid-format Nazi newspaper published by Julius Streicher (a prominent official in the Nazi Party) from 1923 to the end of World War II, with brief suspensions in publication due to legal difficulties. It was a significant part of Nazi propaganda and was vehemently anti-Semitic.

1924

The National Origins Quota of 1924 and Immigration Act of 1924 largely halted immigration to the U.S. from Eastern Europe and Russia; this was meant to restrict Eastern European Jews among others, as a great many of these immigrants coming from Russia and Eastern Europe were Jews (the "outbreak of antisemitism" mentioned in the above entry may have also played a part in the passage of these acts).

1925

The Ku Klux Klan in Prophecy is a 144-page book written by Bishop Alma Bridwell White in 1925 and illustrated by Reverend Branford Clarke. This book primarily espouses White's deep fear and hatred of the Roman Catholic Church while also promoting antisemitism, racism against African Americans, white supremacy, and women's equality.

1925

Adolf Hitler publishes Mein Kampf.

1927

The Schwartzbard trial was a sensational 1927 French murder trial that resulted in a mistrial of international proportions. At the trial Sholom Schwartzbard was accused of murdering the Ukrainian immigrant and head of the Ukrainian government-in-exile Symon Petlura in Paris. While the defendant fully admitted to the crime the trial at the end turned in accusation of Petlura's responsibility for the massive 1919–1920 pogroms in Ukraine in which Schwartzbard had lost all 15 members of his family. Instead of Schwartzbard's murder case the trial was turned into a political case against the Ukrainian government. Schwartzbard was acquitted.

1928

The Massena blood libel was an instance of blood libel against Jews in which the Jews of Massena, New York, were falsely accused of the kidnapping and ritual murder of a Christian girl in September 1928.

1929

The ancient Jewish community of Hebron is massacred by local Muslims over rumors that the Jews were planning to seize control of the Temple Mount.

1929

18–20 Jewish residents of Safed were brutally killed in the 1929 Safed massacre.
**1930s**

**1930**

Pogrom against the Jews of Bălți.

**1933, 16 August**

Christie Pits riot takes place in Toronto, Ontario.

**1933**

In a series of lectures delivered at the University of Virginia in 1933, published under the title After Strange Gods: A Primer of Modern Heresy (1934), T.S. Eliot wrote of societal tradition and coherence, "What is still more important [than cultural homogeneity] is unity of religious background, and reasons of race and religion combine to make any large number of free-thinking Jews undesirable." Eliot never re-published this book/lecture.

**1933–1941**

Persecution of Jews in Germany rises until they are stripped of their rights not only as citizens, but also as human beings. During this time antisemitism reached its all-time high.

- Law against Overcrowding of German Schools and Universities
- Law for the Reestablishment of the Professional Civil Service (ban on professions)
- The Reich Flight Tax is used to expropriate funds from Jewish émigrés.

**1934**

2,000 Afghan Jews are expelled from their towns and forced to live in the wilderness.

**1934**

The 1934 Thrace pogroms were a series of violent attacks that occurred in Tekirdağ, Edirne, Kırklareli, and Canakkale. Over 15,000 Jews had to flee from the region.

**1934**

34 Algerian Jews were killed and hundreds were injured by Muslim mobs during the 1934 Constantine pogrom. 200 Jewish stores were raided, the total property damage was estimated at over 150 million Poincare francs. It also sent a quarter of Constantine's Jewish population into poverty.
The first appearance of *The Franklin Prophecy* on the pages of William Dudley Pelley's pro-Nazi weekly magazine *Liberation*. According to the US Congress report:

"The Franklin "Prophecy" is a classic antisemitic canard that falsely claims that American statesman Benjamin Franklin made anti-Jewish statements during the **Constitutional Convention** of 1787. It has found widening acceptance in Muslim and Arab media, where it has been used to criticize Israel and Jews..."

1934

In his 1934 pageant play *The Rock*, T.S. Eliot distances himself from Fascist movements of the thirties by caricaturing Oswald Mosley's Blackshirts, who 'firmly refuse/ To descend to palaver with anthropoid Jews'. The "new evangels" of totalitarianism are presented as antithetical to the spirit of Christianity.

1935

*Nuremberg Laws* introduced. Jewish rights rescinded. The Reich Citizenship Law strips them of citizenship. The Law for the Protection of German Blood and German Honor:

- Marriages between Jews and citizens of German or kindred blood are forbidden.
- Sexual relations outside marriage between Jews and nationals of German or kindred blood are forbidden.
- Jews will not be permitted to employ female citizens of German or kindred blood as domestic servants.
- Jews are forbidden to display the Reich and national flag or the national colors. On the other hand, they are permitted to display the Jewish colors.

1936

*The Bloody Day in Jaffa* refers to various violent attacks on Jews in Jaffa by mobs of Muslims.

1936

The *Przytyk pogrom* was an altercation between Jewish and Polish peasants, ending with two Jews and one Pole dead.

1936

Cardinal August Hlond, as Primate of Poland issued a pastoral letter on Catholic moral principles. The long (5600-word) letter covered Catholic ethics policy, ethics principles and a section on "sins" (Z Naszych Grzechów) that addressed Christian shortcomings to **love one's neighbours** in accordance with God's law. The latter section included a brief discussion of the "Jewish problem" (Problem żydowski): "So long as Jews remain Jews, a Jewish problem exists and will continue to exist (...) It is a fact that Jews are waging war against the Catholic church, that they are steeped in free-thinking, and constitute the vanguard of
atheism, the Bolshevik movement, and revolutionary activity. It is a fact that Jews have a corruptive influence on morals and that their publishing houses are spreading pornography. It is true that Jews are perpetrating fraud, practicing usury, and dealing in prostitution. It is true that, from a religious and ethical point of view, Jewish youth are having a negative influence on the Catholic youth in our schools." Hlond tempered these remarks with an admission that "not all Jews are this way" and forbade assaults on Jews or attacks on their property. Yet, despite a warning to Catholics not to take an anti-Jewish moral stance, interspersed in the letter’s words of friendship was an explicit condemnation of Jewish culture and also Judaism for its rejection of Jesus Christ: "It is good to prefer your own kind when shopping, to avoid Jewish stores and Jewish stalls in the marketplace (...) One should stay away from the harmful moral influence of Jews, keep away from their anti-Christian culture, and especially boycott the Jewish press and demoralizing Jewish publications. (...) We do not honor the indescribable tragedy of that nation, which was the guardian of the idea of the Messiah and from which was born the Savior. When divine mercy enlightens a Jew to sincerely accept his and our Messiah, let us greet him into our Christian ranks with joy." Hlond's letter was criticized by Polish Jewish groups who saw it as offering support and a rationalization for antisemitism. What also caught the attention of historians was the remark about not hating anyone, "not even Jews", implying "not even enemies". Were Jews to be loved as neighbors or enemies? However, while Hlond promoted the expulsion of German civilians after World War II, he had always consistently condemned the Nazi persecution of the Jews.

1937

"The Eternal Jew" was the title of an exhibition of degenerate art (entartete Kunst) displayed at the Library of the German Museum in Munich from 8 November 1937 to 31 January 1938. The exhibition attracted 412,300 visitors, over 5,000 per day.

1938

Ecuador issues an order that states all Ecuadorian Jewish residents not working in agriculture need to leave the country.

1938

Anschluss, pogroms in Vienna, anti-Jewish legislation, deportations to Nazi concentration camps.

- Decree authorizing local authorities to bar Jews from the streets on certain days
- Decree empowering the justice Ministry to void wills offending the "sound judgment of the people"
- Decree providing for the compulsory sale of Jewish real estate
- Decree providing for the liquidation of Jewish real estate agencies, brokerage agencies, and marriage agencies catering to non-Jews
- Directive providing for the concentration of Jews in houses
1938 July 6–15

Evian Conference: 31 countries refuse to accept Jews trying to escape Nazi Germany (with the exception of Dominican Republic). Most find temporary refuge in Poland. See also Bermuda Conference.

1938

Arab rioters rush into the Jewish Kiryat Shmuel neighborhood, killing 19 Jews, 11 of whom were children in the 1938 Tiberias massacre.

1938

Father Charles E. Coughlin, a Roman Catholic priest, starts antisemitic weekly radio broadcasts in the United States.

1938

Kristallnacht (Night of The Broken Glass). In one night most German synagogues and hundreds of Jewish-owned German businesses are destroyed. Almost 100 Jews are killed, and 10,000 are sent to concentration camps.

1938

Racial legislation introduced in Italy. Anti Jewish economic legislation introduced in Hungary.

1938

Der Giftpilz is a children’s book published by Julius Streicher in 1938. The title is German for "the toadstool" or "the poisonous mushroom". The book was intended as anti-Semitic propaganda. The text is by Ernst Hiemer, with illustrations by Philipp Rupprecht (also known as Fips).

1939

The "Voyage of the damned": S.S. St. Louis, carrying 907 Jewish refugees from Germany, is turned back by Canada, Cuba and the US. After they were denied entry to those places, the refugees were finally accepted in various European countries, including Belgium, the Netherlands, the UK, and France. Historians have estimated that approximately a quarter of them died in death camps during World War II.

1939

In this year Ezra Pound returned to Italy from the States and began writing antisemitic material for Italian newspapers. He wrote to James Laughlin that Roosevelt represented Jewry, and signed the letter with "Heil Hitler".

1939

Linen from Ireland is a 1939 German drama film that was part of an ongoing campaign of antisemitism in German cinema of the era, and it also attacked Britain with whom Germany was at war by the time of the film's release.
1939

Robert and Bertram is a 1939 German musical comedy film; it was the only anti-semitic musical comedy released during the Nazi era.

1939 February

The Congress of the United States rejects the Wagner-Rogers Bill, an effort to admit 20,000 Jewish refugee children under the age of 14 from Nazi Germany.

1939–1945

The Holocaust. About 6 million Jews, including about 1 million children, systematically killed by Nazi Germany and other Axis powers. See also Holocaust denial.

1939–1958

Some post-war critics have accused Pope Pius XII, who had his papacy in 1939–1958, of either being overly cautious, or of "not doing enough," or even of "silence" in the face of the Holocaust. Yet, by the writings of Jewish men and women and mainly the Israeli State archives, it is well established that Pope Pius XII supervised a secret rescue network which saved approximately 800,000 Jewish lives.

1940s

1940

On 16 May 1940 the Administrasjonsrådet asked Rikskommisariatet why radio receivers had been confiscated from Jews in Norway. That Administrasjonsrådet thereafter "quietly" accepted racial segregation between Norwegian citizens, has been claimed by Tor Bomann-Larsen. Furthermore, he claimed that this segregation "created a precedent." Two years later (with NS-styret in the ministries of Norway) Norwegian police arrested citizens at the addresses where radios had previously been confiscated from Jews.

1940

In the Vichy regime: 10 July 1940 – Pierre Laval induces Parliament to vote complete powers (constituent, legislative, executive and judicial) to Marshal Philippe Pétain who becomes Head of state of the French State (État français). 21 July 1940 – Minister of Justice Raphaël Alibert creates a board to review 500,000 naturalizations accorded since 1927. Withdrawal of nationality for 15,000 people, 40% of whom were Jews. July 1940 – The Germans expel more than 20,000 Alsace-Lorraine Jews to the southern zone. 27 September 1940 – Ordinance on the status of Jews in the Occupied Zone. A census of Jews ("the Tulard file") and obligatory sign indicating "Jew" on shops owned by Jews. 27 September 1940 – A Vichy law
allows any foreigner "redundant to the French economy" to be interned among "groups of foreign workers".

3 October 1940 – first law on the status of Jews. French Jewish citizens are excluded from civil service, army, education, the press, radio and film. "Surplus" Jews are excluded from the professions. Article 9: This law is applicable to Algeria, to the colonies, protectorates and mandated territories. 4 October 1940 – prefects can detain foreigners of Jewish extraction in special camps or to assign residence. 7 October 1940 – repeal of the 1871 Crémieux Decree; French nationality is removed from Jews from Algeria. 7 October 1940 – Aryanization of businesses in the Occupied Zone.

1940

Jud Süß is a 1940 Nazi propaganda film produced by Terra Filmkunst at the behest of Joseph Goebbels, and considered one of the most antisemitic films of all time. The film has been characterized as "one of the most notorious and successful pieces of antisemitic film propaganda produced in Nazi Germany." It was a great success in Germany, with some 20 million viewers. Although the film's budget of 2 million Reichsmarks was considered high for films of that era, the box office receipts of 6.5 million Reichsmarks made it a financial success. Heinrich Himmler urged members of the SS and police to watch the movie.

1940

The Rothschilds is a 1940 German film directed by Erich Waschneck. It portrays the role of the Rothschild family in the Napoleonic Wars. The Jewish Rothschilds are depicted in a negative manner, consistent with the anti-Semitic policy of Nazi Germany.

1940

Vom Bäumlein, das andere Blätter hat gewollt is a short anti-Semitic propaganda cartoon produced in 1940 in the Nazi movie studio Zeichenfilm GmbH.

1940

The Eternal Jew (1940) is an antisemitic German Nazi propaganda film, presented as a documentary.

1941

The Farhud pogrom in Baghdad results in 780 Jews dead, over 1,000 wounded.

1941

Gabès pogrom in French Tunisia leaves 8 Jews dead and at least 20 wounded.

1941

Iași pogrom in Iași city was the incident where more than 13,266 Jews were killed by angry mobs of locals, and together with military personnel they exterminated about 1/3 of Jewish population in Romania.
Encouraged by the Nazis, Ukrainian militias and local mobs perpetrated the Lviv pogroms, killing around 6,000 Polish Jews.

1941

Some villagers in Jedwabne, Poland burned at least 340 local Jews alive.

1941

Nazis and their collaborators shot to death 33,771 Jews at Babi Yar over the course of two days.

1941

German forces and Latvian collaborators killed around 5,000 Jews in the Liepāja massacres.

1941

In a speech at an America First rally at the Des Moines Coliseum on 11 September 1941, "Who Are the War Agitators?", Charles Lindbergh warned of the Jewish people's "large ownership and influence in our motion pictures, our press, our radio, and our government" and claimed the three groups "pressing this country toward war [are] the British, the Jewish, and the Roosevelt Administration", and said of Jewish groups,

1941

Collaboration of the Vichy regime with the Holocaust: 29 March 1941: creation of the Commissariat-General for Jewish Affairs (CGJ), with Xavier Vallat as the first commissioner. 11 May 1941 – Creation of the French Institute for Jewish Affairs, an anti-Semitic propaganda agency, financed by the nazis (Theodor Dannecker) and directed by French antisemitic agitators Paul Sézille (fr), René Gérard (fr) and others. 14 May 1941 – the Billet Vert roundup (fr) organized by the Prefecture of Police with the agreement of the general delegation of the French government in the occupied zone and upon demand by the occupying authorities: 3,747 Jewish foreigners, (out of 6,494 summoned by the prefecture) were crammed into the Pithiviers and Beaune-la-Rolande internment camps under French administration. 2 June 1941 – second law concerning Jews. Compared to the first one, an increasingly stringent definition of who is a Jew, additional professional work restrictions, quotas in University (3%) and the liberal professions (2%). Jews were obligated to take part in a census in the Zone libre. Article 11 of the Statute: "This law is applicable to Algeria, the colonies, protectorates and territories under mandate. This law authorizes prefects to perform administrative detention of Jews of French nationality." 21 July 1941 – Aryanization of Jewish companies in the Zone libre. August 1941: Occupied zone: internment of 3,200 foreign and 1,000 French Jews in various camps including Drancy. December 1941 – Occupied zone: 740 French Jews, members of the liberal and intellectual professions, interned in Compiègne.

January 1942
The Wannsee Conference in Berlin: Nazi officials define the practical arrangements for the "Final Solution", that is to say, the complete extermination of European Jewry, including children.

1942

The Antisemitic Exhibition in Zagreb took place in the Art Pavilion in Zagreb, the capital city of the Independent State of Croatia (NDH), in May 1942. According to its organizers, the exhibition sought to expose the "destructive and exploitative work of Croatia's Jews prior to 1941."

1942


1943

Vienna 1910 is a 1943 German biographical film directed by Emerich Walter Emo and starring Rudolf Forster, Heinrich George and Lil Dagover. It is based on the life of Mayor of Vienna Karl Lueger. Its antisemitic content led to it being banned by the Allied Occupation forces following World War II.

1943

Forces occultes is a French film of 1943 that virulently denounces Jews, Freemasonry, and parliamentarianism as part of the Vichy regime's drive against them and seeks to prove a Jewish-Masonic plot.

1943

Collaboration of the Vichy regime with the Holocaust: January 1943 – Roundup of Marseille: destruction of the Old Port and roundups by French authorities. Nearly 2,000 Marseilles Jews arrested and deported. Le Petit Marseillais of 30 January 1943 wrote: "Note that the evacuation operations in the Northern district of the Old Port were carried out exclusively by French police and that no incidents were reported. The Opera district, where many Sephardic families lived, is emptied of its inhabitants. February 1943 – Lyon raid on the premises of the Union générale des israélites de France (fr) (UGIF). September 8, 1943 – surrender of Italy leading to the Allied occupation of Italian-occupied France hitherto spared the roundups. April 1943 – Nîmes and Avignon roundups. September 1943 – roundups of Nice and surrounding area."
The Bermuda Conference was an international conference between the United Kingdom and the United States held from 19 April 1943, through 30 April 1943, at Hamilton, Bermuda. The topic of discussion was the question of Jewish refugees who had been liberated by Allied forces and those who still remained in Nazi-occupied Europe. The only agreement made was that the war must be won against the Nazis. US immigration quotas were not raised nor was the British prohibition on Jewish refugees seeking refuge in the British Mandate of Palestine lifted.

1944
Collaboration of the Vichy regime with the Holocaust: February 1944 – roundups of Grenoble and Isère. 15 August 1944 – last deportation convoy from Clermont-Ferrand.

1945
The 1945 Tripoli pogrom was a violent massacre of the Jewish population of Tripoli by Muslim rioters. After days of violence 140+ Jews were dead and hundreds were injured. In the aftermath 4,000 Jews were left homeless and thousands were reduced to poverty. 9 Synagogues were destroyed, along with thousands of Jewish homes and businesses.

1945
The 1945 Anti-Jewish riots in Egypt started as an anti-Zionist demonstration, but it ended with the killing of 5 Egyptian Zionists by a Muslim mob and over 300 other Jews were injured.

1945
Bess Myerson was the first Jewish-American and the first Miss New York (competing as Miss New York City, a competition organized by a local radio station) to win the Miss America Pageant as Miss America 1945. As the only Jewish contestant, Myerson was encouraged by the pageant directors to change her name to "Bess Meredith" or "Beth Merrick" but she refused. After winning the title (and as a Jewish Miss America), Myerson received few endorsements and later recalled that "I couldn't even stay in certain hotels [...] there would be signs that read no coloreds, no Jews, no dogs. I felt so rejected. Here I was chosen to represent American womanhood and then America treated me like this." She thus cut short her Miss America tour and instead traveled with the Anti-Defamation League. In this capacity, she spoke against discrimination in a talk entitled, "You Can't Be Beautiful and Hate."

1945
The Kraków pogrom was a post-WW2 pogrom, resulting in the death of Auschwitz survivor Róża Berger.

1946
The Kielce pogrom. 40 Jews were massacred and 80 other Jews were wounded out of about 200 who had returned home after World War II had ended. 2 non-Jewish Poles were also killed. Controversy was caused by August Hlond's reaction to the Kielce pogrom. While condemning murders, Hlond denied the racist
nature of this crime. He saw the pogrom as a reaction against Jewish bureaucrats serving the Communist regime. This position was echoed by Cardinal Sapieha, who was reported to have said that the Jews brought it on themselves.

1946

Nikita Khrushchey, then the first secretary of the Communist party of Ukraine, closes many synagogues (the number declines from 450 to 60) and prevents Jewish refugees from returning to their homes.

1946

The post-WW2 Kunmadaras pogrom was the killing of 6 Jewish Holocaust survivors in Kunmadaras, Hungary.

1946

The Miskolc pogrom

1947

Anti-Jewish riots erupt in Aleppo, resulting in some 75 Jews murdered and several hundred wounded.

1947

A mob of Muslim sailors looted Jewish homes and shops in the Manama riots. In the end one Jewish woman was dead and a Synagogue was destroyed.

1947

A three-day riot broke out between the Jews of Aden and the local Muslim population. When it was over, 82 Jews were killed and 76 Jews were injured.

1947

In Austria, the Verbotsgesetz 1947 provided the legal framework for the process of denazification in Austria and the suppression of any potential revival of Nazism. In 1992, it was amended to prohibit the denial or gross minimisation of the Holocaust.

National Socialism Prohibition Law (1947, amendments of 1992)

§ 3g. He who operates in a manner characterized other than that in § § 3a – 3f will be punished (revitalising of the NSDAP or identification with), with imprisonment from one to up to ten years, and in cases of particularly dangerous suspects or activity, be punished with up to twenty years' imprisonment.

§ 3h. As an amendment to § 3 g., whoever denies, grossly plays down, approves or tries to excuse the National Socialist genocide or other National Socialist crimes against humanity in a print publication, in broadcast or other media.
1947, 5 December

1947 Manama riots.

1948–2001

Antisemitism played a major role in the Jewish exodus from Arab lands. The Jewish population in the Arab Middle East and North Africa has decreased from 900,000 in 1948 to less than 8,000 in 2001.

1948

The Djerda was a pogrom against the tiny Jewish population of Jerada at the hands of the local Muslims. It ended with 43 Jews dead and around 150 Jews injured.

1948

The 1948 Anti-Jewish riots in Tripolitania was a riot between the Jewish and Arab populations of Tripoli. Unlike the previous Tripoli pogrom, the Jewish community of Tripoli fought back against the Muslim rioters. When it was over, 14 Jews and 4 Muslims were dead and many on both sides were injured.

1948

The 1948 Cairo bombings were several bombings which targeted the Jewish population of Cairo. The bombings claimed the lives of 70 Jews and 200 other Jews were wounded.

1948

The Southern Baptist Convention passed a resolution stating in part, "RESOLVED, That communism, fascism, political ecclesiasticism, and anti-Semitism are utterly contrary to the genius of our Baptist concept of freedom and spiritual values."

1948

Solomon Mikhoels, actor-director of the Moscow State Jewish Theater and chairman of the Jewish Anti-Fascist Committee is killed in a suspicious car accident (see MGB). Mass arrests of prominent Jewish intellectuals and suppression of Jewish culture follow under the banners of campaign on rootless cosmopolitanism and anti-Zionism.

1948

During the Siege of Jerusalem of the 1948 Arab–Israeli War, Arab armies were able to conquer the part of the West Bank and Jerusalem; they expelled all Jews (about 2,000) from the Old City (the Jewish Quarter) and destroyed the ancient synagogues that were in the Old City as well.

1949

The Menarsha synagogue attack was a grenade attack in the Jewish quarter of Damascus that took 12 lives.
1950s

1952

The Night of the Murdered Poets. The thirteen most prominent Soviet Yiddish writers, poets, actors and other intellectuals were executed, among them Peretz Markish, Leib Kvitko, David Hofstein, Itzik Feffer, David Bergelson. In 1955 UN General Assembly's session a high Soviet official still denied the "rumors" about their disappearance.

1952

The Prague Trials in Czechoslovakia.

1953

The Doctors' plot false accusation in the USSR. Scores of Soviet Jews dismissed from their jobs, arrested, some executed. The USSR was accused of pursuing a "new antisemitism." Stalinist opposition to "rootless cosmopolitans" – a euphemism for Jews – was rooted in the belief, as expressed by Klement Gottwald, that "treason and espionage infiltrate the ranks of the Communist Party. This channel is Zionism." This newer antisemitism was, in effect, a species of anti-Zionism.

1953

Holocaust Remembrance Day in Israel is inaugurated.

1956

The Alaska Mental Health Enabling Act of 1956 (Public Law 84-830) was an Act of Congress passed to improve mental health care in the United States territory of Alaska. It became the focus of a major political controversy after opponents nicknamed it the "Siberia Bill" and denounced it as being part of a communist plot to hospitalize and brainwash Americans. Campaigners asserted that it was part of an international Jewish, Roman Catholic or psychiatric conspiracy intended to establish United Nations-run concentration camps in the United States.

1956

Antisemitism swept across Poland as part of a purge of Stalinists.

1958

On 28 April 1958, Birmingham, Alabama, 54 sticks of dynamite were placed outside Temple Beth-El in a bombing attempt. According to police reports, the burning fuses were doused by heavy rainfall, preventing the dynamite from exploding. Although the crime was never solved, police considered Bobby Frank Cherry, later convicted of bombing the Sixteenth Street Baptist Church, to be a suspect.
The Hebrew Benevolent Congregation Temple bombing occurred on 12 October 1958. The Temple, on Peachtree Street in Atlanta, Georgia, housed a Reform Jewish congregation. The building was damaged extensively by the dynamite-fueled explosion, although no one was injured. Five suspects were arrested almost immediately after the bombing. One of them, George Bright, was tried twice. His first trial ended with a hung jury and his second with an acquittal. As a result of Bright's acquittal the other suspects were not tried, and no one was ever convicted of the bombing.

1959

Impeachment of Man is a book by Savitri Devi, first published in 1959, in which she recounts a history of the general indifference toward the suffering of non-human life. She puts forth a pro-vegetarian, anti-vivisectionist, biocentric, and misanthropic conservationist point of view. However, she does so within the context of her pro-Hitler and pro-Nazi political views, and devotes space to antisemitism and denouncing Jewish dietary practices.

1959

On 21 March 1959, Pope John XXIII ordered that the word "faithless" (Latin: perfidis) be removed from the prayer for the conversion of the Jews, actually interrupting the Service and asking the prayer to be repeated without that word. This word had caused much trouble in recent times because of misconceptions that the Latin perfidis was equivalent to "perfidious", giving birth to the view that the prayer accused the Jews of treachery (perfidy), though the word is more correctly translated as "faithless" or "unbelieving". Accordingly, the prayer was revised to read:

Let us pray also for the Jews: that almighty God may remove the veil from their hearts; so that they too may acknowledge Jesus Christ our Lord. Let us pray. Let us kneel. Arise. Almighty and eternal God, who dost also not exclude from thy mercy the Jews: hear our prayers, which we offer for the blindness of that people; that acknowledging the light of thy Truth, which is Christ, they may be delivered from their darkness. Through the same our Lord Jesus Christ, who liveth and reigneth with thee in the unity of the Holy Spirit, God, for ever and ever. Amen. On Good Friday of 1963, by mistake the old text of the prayer was given to the deacon, who read "perfidis". Pope John XXIII interrupted the liturgy again, and ordered that the prayer be repeated with the word omitted.

1960s

Chess player Bobby Fischer made numerous anti-Jewish statements and professed a general hatred for Jews since at least the early 1960s. Although Fischer described his mother as Jewish in a 1962 interview, he later denied his Jewish ancestry.
The Badges Act 1960 (Abzeichengesetz 1960) prohibits the public display of Nazi symbols in Austria, and violations are punishable by up to €4000.- fine and up to 1 month imprisonment.

On 25 March, 1960, the synagogue Congregation Beth Israel and its members were subject to an antisemitic attack. About 180 members were attending a Friday evening service to dedicate the new Zemurray Social Hall, and led by then-rabbi Saul Rubin and Rev. John Speaks and Dr. Franklin Denson of First Methodist Church, when windows were smashed and the synagogue fire-bombed. Two members—Alvin Lowi and Alan Cohn—who rushed out to see what was happening were met by Jerry Hunt, a 16-year-old Nazi sympathizer, who wounded them both with a shotgun, then fled. Lowi was just shot in the hand, but one of Cohn's aortas was nicked, and he almost died, requiring 22 US pints (10 l) of blood. Earlier that week Hunt had attended a rally for antisemitic and white supremacist politician John G. Crommelin, and had had a fight with a Jewish boy over a chess game at the Gadsden Community Centre.

In 1961, a protégé of Harry Elmer Barnes, David Hoggan published Der Erzwungene Krieg (The Forced War) in West Germany, which claimed that Germany had been the victim of an Anglo-Polish conspiracy in 1939. Though Der Erzwungene Krieg was primarily concerned with the origins of World War II, it also down-played or justified the effects of Nazi antisemitic measures in the pre-1939 period. For example, Hoggan justified the huge one billion Reich-mark fine imposed on the entire Jewish community in Germany after the 1938 Kristallnacht as a reasonable measure to prevent what he called "Jewish profiteering" at the expense of German insurance companies and alleged that no Jews were killed in the Kristallnacht (in fact, 91 German Jews were killed in the Kristallnacht).

In his 1962 pamphlet, Revisionism and Brainwashing, Harry Elmer Barnes claimed that there was a "lack of any serious opposition or concerted challenge to the atrocity stories and other modes of defamation of German national character and conduct". Barnes argued that there was "a failure to point out the atrocities of the Allies were more brutal, painful, mortal and numerous than the most extreme allegations made against the Germans". He claimed that in order to justify the "horrors and evils of the Second World War", the Allies made the Nazis the "scapegoat" for their own misdeeds.

"Judaism Without Embellishments" published by the Academy of Sciences of the Ukrainian SSR in 1963.

In a 1964 article, "Zionist Fraud", published in the American Mercury, Harry Elmer Barnes wrote: "The courageous author [Rassinier] lays the chief blame for misrepresentation on those whom we must call the
swindlers of the crematoria, the Israeli politicians who derive billions of marks from nonexistent, mythical and imaginary cadavers, whose numbers have been reckoned in an unusually distorted and dishonest manner. Using Rassinier as his source, Barnes claimed that Germany was the victim of aggression in both 1914 and 1939, and that reports of the Holocaust were propaganda to justify a war of aggression against Germany.

1964

Nasser told a German newspaper in 1964 that "no person, not even the most simple one, takes seriously the lie of the six million Jews that were murdered [in the Holocaust]."

1964

The Roman Catholic Church under Pope Paul VI issues the document Nostra aetate as part of Vatican II, repudiating the doctrine of Jewish guilt for the Crucifixion.

1964

In 1964, French historian Paul Rassinier published The Drama of the European Jews. Rassinier was himself a concentration camp survivor (he was held in Buchenwald for having helped French Jews escape the Nazis), and modern-day holocaust deniers continue to cite his works as scholarly research that questions the accepted facts of the Holocaust. Critics argued that Rassinier did not cite evidence for his claims and ignored information that contradicted his assertions; he nevertheless remains influential in Holocaust denial circles for being one of the first deniers to propose that a vast Zionist/Allied/Soviet conspiracy faked the Holocaust, a theme that would be picked up in later years by other authors.

1964

The Civil Rights Act of 1964 (Pub.L. 88–352, 78 Stat. 241, enacted July 2, 1964) is a landmark piece of civil rights legislation in the United States that outlawed discrimination based on religion, race, color, sex, or national origin.

1965

The Frankfurt Auschwitz trials, known in German as der Auschwitz-Prozess, or der zweite Auschwitz-Prozess, (the "second Auschwitz trial") was a series of trials running from 20 December 1963 to 19 August 1965, charging 22 defendants under German criminal law for their roles in the Holocaust as mid- to lower-level officials in the Auschwitz-Birkenau death and concentration camp complex. Hans Hofmeyer led as Chief Judge the "criminal case against Mulka and others" (reference number 4 Ks 2/63).

Overall, only 789 individuals of the approximately 6,500 surviving SS personnel who served at Auschwitz and its sub-camps were ever tried, of which 750 received sentences. Unlike the first trial in Poland held almost two decades earlier, the trials in Frankfurt were not based on the legal definition of crimes against humanity as recognized by international law, but according to the state laws of the Federal Republic.
1967

Allen Ginsberg stated that, in a private conversation in 1967, Ezra Pound told the young poet, "my poems don't make sense." He went on to supposedly call himself a "moron", to characterize his writing as "stupid and ignorant", "a mess". Ginsberg reassured Pound that he "had shown us the way", but Pound refused to be mollified:

'Any good I've done has been spoiled by bad intentions – the preoccupation with irrelevant and stupid things,' [he] replied. Then very slowly, with emphasis, surely conscious of Ginsberg's being Jewish: 'But the worst mistake I made was that stupid, suburban prejudice of anti-semitism.'

1967

In 1967, Congregation Beth Israel moved to its current location, a building on Old Canton Road described by Jack Nelson as "an octagonal structure dominated by a massive roof". On 18 September 1967 the new building was wrecked by a dynamite bomb placed by Klan members in a recessed doorway. According to Nelson, the explosion had "ripped through administrative offices and a conference room, torn a hole in the ceiling, blown out windows, ruptured a water pipe and buckled a wall." The perpetrators were not discovered. In November of that year the same group planted a bomb that blew out the front of the house of Dr. Perry Nussbaum (Beth Israel's rabbi from 1954 to 1973), while he and his wife were sleeping there.

1967

All Jewish men in Egypt were placed in camps in 1967 during the Six-Day War, and they were kept there for more than two years; Karaite Jews were the last to leave.

1968–1971

State-supported anti-Semitism swept across Poland in 1968, not subsiding until 1971, by which time half of Poland's Jews had fled Poland.

1968

During the American Civil Rights Movement in the 1960s, the leadership of Beth Israel spoke out against the Ku Klux Klan's attacks on black churches. In response, Thomas Tarrants of Mobile, Alabama, who had helped bomb the synagogue building of a different synagogue, Beth Israel Congregation, and its rabbi's house there (see previous entry in this timeline) bombed Beth Israel's education building on 28 May 1968. The force of the blast knocked down several walls of the education building and caved in part of the roof while also destroying a door at the opposite end of the synagogue building. A hole approximately 24 inches (61 cm) in diameter was left in the concrete floor, and damages were estimated to be around $50,000 (equivalent to $368,000 today). According to Sammy Feltenstein, past president of Congregation Beth Israel, pieces of stained glass that survived the bombing were salvaged and adorn the front window of the synagogue today. Later that year, on 30 June, Tarrants returned to Meridian to bomb the home of Meyer
Davidson, an outspoken leader of the Jewish community, on 29th Avenue. But the FBI and police chief Roy Gunn convinced Raymond and Alton Wayne Roberts, local Klan members, to gather information about the Klan's operations, and leaders of the Jewish communities in Jackson and in Meridian had raised money to pay the two informants, who tipped off the FBI about the attack before it happened.

1969

David Hoggan explicitly denied the Holocaust in 1969 in a book entitled The Myth of the Six Million, which was published by the Noontide Press, a small Los Angeles publisher specializing in antisemitic literature.

1960s–1991

The rise of Zionology in the Soviet Union. In 1983, the Department of Propaganda and the KGB's Anti-Zionist committee of the Soviet public orchestrates formally "anti-Zionist" campaign.

1968

Polish 1968 political crisis. The state-organized antisemitic campaign in the People's Republic of Poland under guise of "anti-Zionism" drives out most of remaining Jewish population.

1968

The ancient Jewish community of Hebron, which had been destroyed in the 1929 Hebron massacre, is revived at Kiryat Arba. The community, in 1979 and afterwards, moves into Hebron proper and rebuilds the demolished Abraham Avinu Synagogue, the site of which had been used by Jordan as a cattle-pen.

1968

The Alhambra Decree was formally revoked on 16 December 1968.

1968

The Fair Housing Act (Title VIII of the Civil Rights Act of 1968) in the United States introduced meaningful federal enforcement mechanisms. It outlawed:

- Refusal to sell or rent a dwelling to any person because of race, color, religion, sex, or national origin.
- Discrimination based on race, color, religion or national origin in the terms, conditions or privilege of the sale or rental of a dwelling.
- Advertising the sale or rental of a dwelling indicating preference of discrimination based on race, color, religion or national origin.
- Coercing, threatening, intimidating, or interfering with a person's enjoyment or exercise of housing rights based on discriminatory reasons or retaliating against a person or organization that aids or encourages the exercise or enjoyment of fair housing rights.
1969 November 9

Tupamaros West-Berlin attempted to bomb of West Berlin's Jewish Community Centre. The bomb, supplied by the undercover government agent Peter Urbach, failed to explode.

1970s

Lyndon LaRouche and his ideas have been called antisemitic since at least the mid-1970s by dozens of individuals and organizations in countries across Europe and North America. LaRouche and his followers have responded to these allegations by claiming that LaRouche has Jewish supporters and by denying the accusations.

1970

Canada has no legislation specifically restricting the ownership, display, purchase, import or export of Nazi flags. However, sections 318–320 of the Criminal Code, adopted by Canada's parliament in 1970 and based in large part on the 1965 Cohen Committee recommendations, provide law enforcement agencies with broad scope to intervene if such flags are used to communicate hatred in a public place (particularly sections 319(1), 319(2), and 319(7).

1970

After the Second Vatican Council, the Good Friday prayer for the Jews was completely revised for the 1970 edition of the Roman Missal. Because of the possibility of a misinterpretation similar to that of the word "perfidis" (see above in 1959), the reference to the veil on the hearts of the Jews, which was based on 2 Corinthians 3:14, was removed. The 1973 ICEL English translation of the revised prayer is as follows:

Let us pray for the Jewish people, the first to hear the word of God, that they may continue to grow in the love of his name and in faithfulness to his covenant. (Prayer in silence. Then the priest says:) Almighty and eternal God, long ago you gave your promise to Abraham and his posterity. Listen to your Church as we pray that the people you first made your own may arrive at the fullness of redemption. We ask this through Christ our Lord. Amen.

1971

The ban on Jewish immigration to Israel from the Soviet Union was lifted in 1971 leading to the 1970s Soviet Union aliyah.
The Southern Baptist Convention passed a resolution stating in part, "we point out particularly one area of concern known as anti-Semitism, which some think erroneously is inherent in Christianity, and which we disavow."

1971

To further the goal of reconciliation, the Catholic Church established an internal International Catholic-Jewish Liaison Committee and the International Jewish Committee for Interreligious Consultations. (This Committee is not a part of the Church's Magisterium.)

1972

The Southern Baptist Convention passed a "Resolution on Anti-Semitism" stating in part:

"Therefore, be it RESOLVED, That this Convention go on record as opposed to any and all forms of anti-Semitism; that it declare anti-Semitism unchristian; that we messengers to this Convention pledge ourselves to combat anti-Semitism in every honorable, Christian way."

"Be it further RESOLVED, That Southern Baptists covenant to work positively to replace all anti-Semitic bias with the Christian attitude and practice of love for Jews, who along with all other men, are equally beloved of God."

1972

11 Israeli Olympic athletes are taken hostage and eventually tortured and killed in the Munich massacre.

1974

Four Jewish girls were raped, murdered and mutilated after attempting to flee to Israel. Their bodies were discovered by border police in a cave in the Zabdani Mountains northwest of Damascus along with the remains of two Jewish boys, Natan Shaya 18 and Kassem Abadi 20, victims of an earlier massacre. Syrian authorities deposited the bodies of all six in sacks before the homes of their parents in the Jewish ghetto in Damascus.

1974

Did Six Million Really Die? The Truth at Last is a Holocaust denial pamphlet allegedly written by British National Front member Richard Verrall under the pseudonym Richard E. Harwood and published by Ernst Zündel in 1974.

1975

The United Nations passed a resolution determining that "Zionism is a form of racism and racial discrimination." (It was revoked in 1991, as mentioned below.)
**Arthur Butz**'s *The Hoax of the Twentieth Century*: The case against the presumed extermination of European Jewry was published.

**1977**

**David Irving**'s Holocaust denying book *Hitler's War* was published.

**1977 March 9–11**


**1977 October 3**

In suburban St. Louis, Missouri, Joseph Paul Franklin hid in the bushes near a Shaare Zedek Synagogue (University City, Missouri) and fired on a group attending services. In this incident, Franklin killed forty-two-year-old Gerald Gordon and wounded Steven Goldman and William Ash.

**1977**

In a 1977 Globe-Democrat column discussing John Toland's biography of Adolf Hitler, Pat Buchanan wrote:

Though Hitler was indeed racist and anti-Semitic to the core, a man who without compunction could commit murder and genocide, he was also an individual of great courage, a soldier's soldier in the Great War, a political organizer of the first rank, a leader steeped in the history of Europe, who possessed oratorical powers that could awe even those who despised him... Hitler's success was not based on his extraordinary gifts alone. His genius was an intuitive sense of the mushiness, the character flaws, the weakness masquerading as morality that was in the hearts of the statesmen who stood in his path. Buchanan supporters say the paragraph is taken out of context. They point out that in the same review Buchanan praised Winston Churchill for seeing that "Hitler was marching along the road toward a New Order where Western civilization would not survive" and concluded that modern-day statesmen were not following that example.

**1977**

**National Socialist Party of America v. Village of Skokie**, 432 U.S. 43 (1977) (also known as *Smith v. Collin*; sometimes referred to as the *Skokie Affair*), was a United States Supreme Court case dealing with freedom of assembly. The outcome was that the Illinois Supreme Court ruled that the use of the swastika is a symbolic form of free speech entitled to First Amendment protections and determined that the swastika itself did not constitute "fighting words." Its ruling allowed the National Socialist Party of America to march.¹²³

**1978**

In 1978 Willis Carto founded the Institute for Historical Review (IHR), an organization dedicated to publicly challenging the commonly accepted history of the Holocaust.
1978/1979
In December 1978 and January 1979, Robert Faurisson, a French professor of literature at the University of Lyon, wrote two letters to Le Monde claiming that the gas chambers used by the Nazis to exterminate the Jews did not exist.

1979
A House Joint resolution 1014 designated 28 and 29 April 1979 as "The Days of Remembrance of the Victims of the Holocaust (DRVH)." After that the Days of Remembrance of the Victims of the Holocaust (DRVH) has been an annual 8-day period designated by the United States Congress for civic commemorations and special educational programs that help citizens remember and draw lessons from the Holocaust.

1979
When the Anti-Defamation League accused Lyndon LaRouche of antisemitism in 1979, he filed a $26-million libel suit; however, the case failed when Justice Michael Dontzin of the New York Supreme Court ruled that it was fair comment, and that the facts "reasonably give rise" to that description.

1979
"Jewish Princess" is a song by Frank Zappa released on his album Sheik Yerbouti in 1979. The song is a humorous look at the Jewish-American princess stereotype which attracted attention from the Anti-Defamation League, to which Zappa denied an apology, arguing: "Unlike the unicorn, such creatures do exist – and deserve to be 'commemorated' with their own special opus". In an interview with Spin magazine he was almost offended saying, "...as if to say there is no such thing as a Jewish Princess. Like I invented this?" Biographer Barry Miles claimed in his book, Frank Zappa (Atlantic Books of London, 2005), that the ADL asked the Federal Communications Commission (FCC) to ban the record from being played on the air – a symbolic effort given that the song was not being played anyway.

1980s

1980, 27 July
1980 Antwerp attack.

1980, 3 October

1980
In 1980, the Institute for Historical Review promised a $50,000 reward to anyone who could prove that Jews were gassed at Auschwitz. Mel Mermelstein wrote a letter to the editors of the LA Times and others
including The Jerusalem Post. The IHR wrote back, offering him $50,000 for proof that Jews were, in fact, gassed in the gas chambers at Auschwitz. Mermelstein, in turn, submitted a notarized account of his internment at Auschwitz and how he witnessed Nazi guards ushering his mother and two sisters and others towards (as he learned later) gas chamber number five. Despite this, the IHR refused to pay the reward. Represented by public interest attorney William John Cox, Mermelstein subsequently sued the IHR in the Superior Court of Los Angeles County for breach of contract, anticipatory repudiation, libel, injurious denial of established fact, intentional infliction of emotional distress, and declaratory relief. On 9 October 1981, both parties in the Mermelstein case filed motions for summary judgment in consideration of which Judge Thomas T. Johnson of the Superior Court of Los Angeles County took "judicial notice of the fact that Jews were gassed to death at the Auschwitz Concentration Camp in Poland during the summer of 1944," judicial notice meaning that the court treated the gas chambers as common knowledge, and therefore did not require evidence that the gas chambers existed. On 5 August 1985, Judge Robert A. Wenke entered a judgment based upon the Stipulation for Entry of Judgment agreed upon by the parties on 22 July 1985. The judgment required IHR and other defendants to pay $90,000 to Mermelstein and to issue a letter of apology to "Mr. Mel Mermelstein, a survivor of Auschwitz-Birkenau and Buchenwald, and all other survivors of Auschwitz" for "pain, anguish and suffering" caused to them.

Early 1980s

Jesse Jackson was criticized in the early 1980s for remarks made to a reporter where he referred to New York City as "Hymietown". (Hymie is a pejorative term for Jews.) Jackson ultimately acknowledged he had used the term, and said he had been wrong; however, he also said that he had considered the conversation with the reporter to be off-the-record at the time he made the remarks. Jackson apologized during a speech before national Jewish leaders in a Manchester, New Hampshire synagogue, but an enduring split between Jackson and many in the Jewish community continued at least through the 1990s.

1981 August 29

1981 Vienna synagogue attack.

1981 October 20

1981 Antwerp synagogue bombing.

1981

The Southern Baptist Convention passed a "Resolution On Anti-Semitism" stating in part, "Be it therefore RESOLVED, That the messengers at the 1981 Southern Baptist Convention meeting in Los Angeles, June 9–11, 1981, commend our Southern Baptist Convention leaders as they seek sincere friendship and meaningful dialogue with our Jewish neighbors."
Elana Steinberg was killed by her husband Steven Steinberg, who claimed that she was a "spoiled, over-indulged brat – the stereotypical Jewish American Princess," and that she made him insane by spending and insisting that he become more successful; he was found not guilty.

1981-3

From 1981 to 1982, Holocaust denier Ernst Zündel had his mailing privileges suspended by the Canadian government on the grounds that he had been using the mail to send hate propaganda, a criminal offence in Canada. Zündel then began shipping from a post office box in Niagara Falls, New York, until the ban on his mailing in Canada was lifted in January 1983.

1982

A bomb placed by neo-Nazis exploded outside the Jewish hunter of Nazis Simon Wiesenthal's house in Vienna on 11 June 1982, after which police guards were stationed outside his home 24 hours a day.

1982 October 9

Great Synagogue of Rome attack takes place.

1982

The thesis of the 1982 doctoral dissertation of Mahmoud Abbas, a co-founder of Fatah and president of the Palestinian National Authority, was "The Secret Connection between the Nazis and the Leaders of the Zionist Movement". In his 1983 book The Other Side: the Secret Relationship Between Nazism and Zionism based on the dissertation, Abbas denied that six million Jews had died in the Holocaust; dismissing it as a "myth" and a "fantastic lie". At most, he wrote, 890,000 Jews were killed by the Germans. Abbas claimed that the number of deaths has been exaggerated for political purposes. "It seems that the interest of the Zionist movement, however, is to inflate this figure [of Holocaust deaths] so that their gains will be greater. This led them to emphasize this figure [six million] in order to gain the solidarity of international public opinion with Zionism. Many scholars have debated the figure of six million and reached stunning conclusions—fixing the number of Jewish victims at only a few hundred thousand." In his March 2006 interview with Haaretz, Abbas stated, "I wrote in detail about the Holocaust and said I did not want to discuss numbers. I quoted an argument between historians in which various numbers of casualties were mentioned. One wrote there were 12 million victims and another wrote there were 800,000. I have no desire to argue with the figures. The Holocaust was a terrible, unforgivable crime against the Jewish nation, a crime against humanity that cannot be accepted by humankind. The Holocaust was a terrible thing and nobody can claim I denied it." While acknowledging the existence of the Holocaust in 2006 and 2014, Abbas has defended the position that Zionists collaborated with the Nazis to perpetrate it. In 2012, Abbas told Al Mayadeen, a Beirut TV station affiliated with Iran and Hezbollah, that he "challenges anyone who can deny that the Zionist movement had ties with the Nazis before World War II".

1982 September 18
Great Synagogue of Europe attacked by a man with a submachine gun, seriously wounding four people. The attack has been attributed to the Abu Nidal Organization.

1983

The Lutheran Church–Missouri Synod officially disassociates itself from "intemperate remarks about Jews" in Luther's works. Since then, many Lutheran church bodies and organizations have issued similar statements.

1984

On the evening of 18 June 1984, Alan Berg was fatally shot in the driveway of his Denver home by members of the white nationalist group The Order. His provocative talk show sought to flush out "the anti-Semitism latent in the area's conservative population". He succeeded in provoking members of The Order to engage him in conversations on this talk show and his "often-abrasive on-air persona" ignited the anger of The Order. Subsequently, members of The Order involved in the killing were identified as being part of a group planning to kill prominent Jews. Ultimately, two members of The Order, David Lane and Bruce Pierce, were convicted for their involvement in the case, though neither of homicide.

1984

In 1984, James Keegstra, a Canadian high-school teacher, was charged under the Canadian Criminal Code for "promoting hatred against an identifiable group by communicating anti-Semitic statements to his students". During class, he would describe Jews as a people of profound evil who had "created the Holocaust to gain sympathy." He also tested his students in exams on his theories and opinion of Jews.

Keegstra was charged under s 281.2(2) of the Criminal Code (now s 319(2), which provides that "Every one who, by communicating statements, other than in private conversation, wilfully promotes hatred against any identifiable group" commits a criminal offence. He was convicted at trial before the Alberta Court of Queen's Bench. The court rejected the argument, advanced by Keegstra and his lawyer, Doug Christie, that promoting hatred is a constitutionally protected freedom of expression as per s 2(b) of the Canadian Charter of Rights and Freedoms. Keegstra appealed to the Alberta Court of Appeal. That court agreed with Keegstra, and he was acquitted. The Crown then appealed the case to the Supreme Court of Canada, which rule by a 4–3 majority that promoting hatred could be justifiably restricted under s 1 of the Charter. The Supreme Court restored Keegstra's conviction. He was fired from his teaching position shortly afterwards.

1985, 22 July

1985 Copenhagen bombings.

1985
At a meeting of the Nation of Islam at Madison Square Garden in 1985, Louis Farrakhan said of the Jews: "And don't you forget, when it's God who puts you in the ovens, it's forever!"

1985

On 24 December 1985, David Lewis Rice, a follower of the right-wing extremist group the Duck Club, gained entry to the Seattle home of civil litigation attorney Charles Goldmark using a toy gun and pretending to be a deliveryman. He tied the family up, chloroformed them into unconsciousness, beat them with a steam iron, and stabbed them. Rice mistakenly believed the family to be Jewish and Communist. In 1998, he pleaded guilty to the crimes in exchange for avoiding the death penalty. The Goldmark Murders remain one of the most notorious antisemitic hate crimes as well as politically motivated killings in recent memory in the United States, even though the victims were not actually Jewish and Communist as the killer mistakenly believed.

1985

Ronald Reagan visited a German military cemetery in Bitburg to lay a wreath with West German Chancellor Helmut Kohl. It was determined that the cemetery held the graves of forty-nine members of the Waffen-SS. Reagan issued a statement that called the Nazi soldiers buried in that cemetery as themselves "victims," a designation which ignited a stir over whether Reagan had equated the SS men to victims of the Holocaust; Pat Buchanan, Reagan's Director of Communications, argued that the president did not equate the SS members with the actual Holocaust. Now strongly urged to cancel the visit, the president responded that it would be wrong to back down on a promise he had made to Chancellor Kohl. He ultimately attended the ceremony where two military generals laid a wreath.

1986

Leo Frank was posthumously pardoned by the Georgia State Board of Pardons and Paroles.

1986

In Israel, a law to criminalize Holocaust denial was passed by the Knesset on 8 July 1986.

1986 September 6

Gunmen opened fire during a Shabbat service in Neve Shalom Synagogue in Istanbul, Turkey which resulted in the death of 22 people. This attack is attributed to the Palestinian militant Abu Nidal.

1987

On 13 September 1987 Jean-Marie Le Pen said, "I ask myself several questions. I'm not saying the gas chambers didn't exist. I haven't seen them myself. I haven't particularly studied the question. But I believe it's just a detail in the history of World War II." He was condemned under the Gayssot Act and ordered to pay 1.2 million francs (183,200 euros).
Pat Buchanan called for ending prosecution of Nazi camp guards, saying it was "running down 70-year-old camp guards."

1987

In 1987, Bradley R. Smith, a former media director of the Institute for Historical Review, founded the Committee for Open Debate on the Holocaust (CODOH).

1987

John Koehler was the communications director for five working days under President Ronald Reagan; Koehler, who was an immigrant from Germany, had been in Hitler Youth.

Since 1987

Activities of Pamyat and other "nonformal" ultra-nationalist organizations in the Soviet Union.

1988

In 1988, the American historian Arno J. Mayer published a book entitled Why Did the Heavens Not Darken?, which did not explicitly deny the Holocaust, but lent support to Holocaust denial by stating that most people who died at Auschwitz were the victims of "natural causes" such as disease, not gassing. Mayer also cited the works of Holocaust deniers Arthur Butz and Paul Rassinier in his book's bibliography. Critics such as Lucy Dawidowicz criticized Mayer's citation of deniers, and argued that his statements about Auschwitz were factually incorrect. Holocaust expert Robert Jan van Pelt has noted that Mayer's book is as close as a mainstream historian has ever come to supporting Holocaust denial. Holocaust deniers such as David Irving have often cited Mayer's book as one reason for embracing Holocaust denial. Though Mayer has been often condemned for his statement about the reasons for the Auschwitz death toll, his book does not deny the use of gas chambers at Auschwitz, as Holocaust deniers often claim.

Some mainstream Holocaust historians have labeled Mayer a denier. The Israeli historian Yehuda Bauer wrote that Mayer "popularizes the nonsense that the Nazis saw in Marxism and Bolshevism their main enemy, and the Jews unfortunately got caught up in this; when he links the destruction of the Jews to the ups and downs of German warfare in the Soviet Union, in a book that is so cocksure of itself that it does not need a proper scientific apparatus, he is really engaging in a much more subtle form of Holocaust denial."

Defenders of Mayer argue that his statement that "Sources for the study of the gas chambers at once rare and unreliable" has been taken out of context, particularly by Holocaust deniers. Michael Shermer and Alex Grobman observe that the paragraph from which the statement is taken asserts that the SS destroyed the majority of the documentation relating to the operation of the gas chambers in the death camps, which is why Mayer feels that sources for the operation of the gas chambers are "rare" and "unreliable".
1988

In February 1988, an improperly drawn swastika and anti-Semitic slogans and "Jesus Lives; You Can't Kill Him" and "Accept Hitler, Respect Christ" were plastered across the synagogue Bet Shira Congregation, and 30 windows were smashed. In response, a neighboring church put a Star of David on its lawn, and its parish donated $1,000 towards repairing the windows. Miami Sunset High School students painted over the anti-Semitic slurs spray-painted by the vandals. Four teenagers, three of whom were football players at Miami Palmetto High School, were sentenced for having vandalized the synagogue to 200 hours of community service and ordered to pay the $14,800 ($32,000 today) in damages.

1989

Finland has no specific legislation aimed at controlling ownership, display, purchase, import or export of Nazi flags, however the Criminal Code (39/1889) (especially Chapter 11 'War crimes and offences against humanity' Section 8) may be applied where an offence has been directed at a person belonging to a national, racial, ethnic or other population group due to his/her membership in such a group.

1990s

1990s

Ruth Bader Ginsburg objected to the United States Supreme Court bar inscribing its certificates "in the year of our Lord", at the request of some Orthodox Jews who opposed it, and due to her objection, Supreme Court bar members have since been given other choices of how to inscribe the year on their certificates.

1990


1990

On five occasions in six weeks vandals shot at windows at the synagogue Bet Shira Congregation. Three teenagers, two of them students at Palmetto High School, were arrested for shooting out the windows.

1990

For his portrayal of Jewish nightclub owners Moe and Josh Flatbush in the 1990 film Mo' Better Blues, Spike Lee drew the ire of the Anti Defamation League, B'nai B'rith, and other such Jewish organizations. The Anti-Defamation League claimed that the characterizations of the nightclub owners "dredge up an age-old and highly dangerous form of anti-Semitic stereotyping", and stated it was "...disappointed that Spike Lee – whose success is largely due to his efforts to break down racial stereotypes and prejudice – has employed the same kind of tactics that he supposedly deplores."
eventually responded in an editorial in The New York Times, alleging "a double standard at work in the accusations of anti-Semitism" given the long history of negative portrayals of African-Americans in film: "Not every black person is a pimp, murderer, prostitute, convict, rapist or drug addict, but that hasn't stopped Hollywood from writing these roles for African-Americans". Lee argues that even if the Flatbush brothers are stereotyped figures, their "10 minutes of screen time" is insignificant when compared to "100 years of Hollywood cinema... [and] a slew of really racist, anti-Semitic filmmakers". According to Lee, his status as a successful African-American artist has led to hostility and unfair treatment: "Don't hold me to a higher moral standard than the rest of my filmmaking colleagues... Now that young black filmmakers have arisen in the film industry, all of a sudden stereotypes are a big issue... I think it's reaching the point where I'm getting reviewed, not my films." Ultimately, however, Lee refused to apologize for his portrayal of the Flatbush brothers: "I stand behind all my work, including my characters, Moe and Josh Flatbush... if critics are telling me that to avoid charges of anti-Semitism, all Jewish characters I write have to be model citizens, and not one can be a villain, cheat or a crook, and that no Jewish people have ever exploited black artists in the history of the entertainment industry, that's unrealistic and unfair."

1990

In France, the Gayssot Act, voted for on 13 July 1990, makes it illegal to question the existence of crimes that fall in the category of crimes against humanity as defined in the London Charter of 1945, on the basis of which Nazi leaders were convicted by the International Military Tribunal at Nuremberg in 1945–46. When the act was challenged by Robert Faurisson, the Human Rights Committee upheld it as a necessary means to counter possible antisemitism.

1990

In a 1990 column defending John Demjanjuk, Pat Buchanan said:

Diesel engines do not emit enough carbon monoxide to kill anybody. In 1988, 97 kids, trapped 400 feet (120 m) underground in a Washington, DC, tunnel while two locomotives spewed diesel exhaust into the car, emerged unharmed after 45 minutes. Demjanjuk's weapon of mass murder cannot kill.

When asked for his source, Buchanan said, "somebody sent it to me." Critic Jamie McCarthy says this claim may have come from the German American Information and Education Association's newsletter, a publication he accused of anti-Semitism and Holocaust denial. He also argues that:

Unlike the locomotive engineer in Buchanan's example, who was concerned with saving the lives of trapped people, the Nazis had no qualms about opening the engine's throttle and restricting the air intake.

The Washington Post had reported in 1989, before the controversy, that:

An Amtrak train had been stalled in a tunnel for half an hour, and smoke from the diesel engine had filled the first car, where there were 97 fifth-grade pupils and 27 adult chaperones. [EMT Cynthia] Brown boarded the train,
guided the passengers – most of whom suffered from smoke inhalation – from the car and assisted those who needed immediate attention.

1990

French literature professor Robert Faurisson was convicted and punished for Holocaust denial under the Gayssot Act in 1990.

1991

The Secret Relationship Between Blacks and Jews, published in 1991, is a book that asserts that Jews dominated the Atlantic slave trade. The book has been labeled an Antisemitic canard by historians including Saul S. Friedman, who writes that Jews had a minimal role in New World slave trade. Henry Louis Gates, Jr., head of the department of Afro-American studies at Harvard University, called the book "the Bible of new anti-Semitism" and added that "the book massively misinterprets the historical record, largely through a process of cunningly selective quotations of often reputable sources".

The book was criticized for being antisemitic, and for failing to provide an objective analysis of the role of Jews in the slave trade. Common criticisms were that the book used selective quotes, made "crude use of statistics," and was purposefully trying to exaggerate the role of Jews.

Historian Ralph A. Austen criticized the book, saying that the "distortions are produced almost entirely by selective citation rather than explicit falsehood.... more frequently there are innuendos imbedded in the accounts of Jewish involvement in the slave trade," and "[w]hile we should not ignore the anti-Semitism of The Secret Relationship..., we must recognize the legitimacy of the stated aim of examining fully and directly even the most uncomfortable elements in our [Black and Jewish] common past." Austen acknowledges that the book was the first book on the subject aimed at a non-scholarly audience.

In 1995, the American Historical Association (AHA) issued a statement condemning "any statement alleging that Jews played a disproportionate role in the Atlantic slave trade."

The publication of The Secret Relationship spurred retorts published specifically to refute the thesis of The Secret Relationship:

- 1993 – Marc Caplan, Jew-Hatred As History: An Analysis of the Nation of Islam's "The Secret Relationship" (Published by the Anti Defamation League).
- 1999 – Saul S. Friedman, Jews and the American Slave Trade, Transaction.

A post-1991 scholar who analyzed the role of Jews in the overall Atlantic slave trade concluded that it was "minimal," and only identified certain regions (such as Brazil and the Caribbean) where the participation was "significant."

Wim Klooster wrote: "In no period did Jews play a leading role as financiers, shipowners, or factors in the Transatlantic or Caribbean slave trades. They possessed far fewer slaves than non-Jews in every British territory in North America and the Caribbean. Even when Jews in a handful of places owned slaves in proportions slightly above their representation among a town's families, such cases do not come close to corroborating the assertions of The Secret Relationship."

The Anti-Defamation League states that Volume Two of The Secret Relationship blames Jews for "promoting a myth of black racial inferiority and makes a range of conspiratorial accusations about Jewish involvement in the slave trade and in the cotton, textiles, and banking industries".

1991

The United Nations's resolution determining that "Zionism is a form of racism and racial discrimination" was revoked.

1991

The Crown Heights riot was a three-day racial riot that occurred from 19–21 August 1991 in the Crown Heights section of Brooklyn, New York City. It turned black residents and Orthodox Jewish residents against each other, causing deteriorated racial relations. The riots began on 19 August 1991, after two children of Guyanese immigrants were unintentionally struck by an automobile in the motorcade of Menachem Mendel Schneerson, the leader of a Jewish religious sect. One child died and the second was severely injured. This event was said to cause tensions between Jewish and black residents to erupt.

In its wake, several Jews were seriously injured; one Orthodox Jewish man was killed; and a non-Jewish man, apparently mistaken by rioters for a Jew, was killed by a group of black men. The riots were a major issue in the 1993 mayoral race, contributing to the defeat of Mayor David Dinkins, an African American, who was blamed for an ineffective police response. Ultimately, black and Jewish leaders developed an outreach program between their communities to help calm and possibly improve racial relations in Crown Heights over the next decade.
1991

In December 1991 the American Historical Association issued the following statement: The American Historical Association Council strongly deplores the publicly reported attempts to deny the fact of the Holocaust. No serious historian questions that the Holocaust took place. This followed a strong reaction by many of its members and commentary in the press against a near-unanimous decision that the AHA had made in May 1991 that studying the significance of the Holocaust should be encouraged. The association's May 1991 statement was in response to an incident where certain of its members had questioned the reality of the Holocaust. The December 1991 declaration is a reversal of the AHA's earlier stance that the association should not set a precedent by certifying historical facts.

1992 March 1

A bomb attack was carried out by two men Neve Shalom Synagogue in Istanbul, Turkey causing no damage or casualties.

1994 February 25

Second Hebron massacre. Baruch Goldstein, a Jew, kills several Muslim worshippers; this leads to riots that kill both Muslims and Jews.

1994

On 1 March 1994, on the Brooklyn Bridge in New York City, Lebanese-born immigrant Rashid Baz shot at a van of 15 Chabad-Lubavitch Orthodox Jewish students that was traveling on the Brooklyn Bridge, killing one and injuring three others.

1994, 20 March

Chris Lord, an individual associated with the Volksfront and American Front, fired ten rounds with an assault rifle into Temple Beth Israel (Eugene, Oregon), damaging the interior.

1994

AMIA bombing against the Jewish community of Buenos Aires.

1995

In February 1995 a Japanese magazine named Marco Polo, a 250,000-circulation monthly published by Bungei Shunju, ran a Holocaust denial article by physician Masanori Nishioka which stated:

The 'Holocaust' is a fabrication. There were no execution gas chambers in Auschwitz or in any other concentration camp. Today, what are displayed as 'gas chambers' at the remains of the Auschwitz camp in Poland are a post-war fabrication by the Polish communist regime or by the Soviet Union, which controlled the country. Not once, neither at Auschwitz nor in any territory controlled by the Germans during the Second World War, was there 'mass murder of Jews' in 'gas chambers.'
The Los Angeles-based Simon Wiesenthal Center instigated a boycott of Bungei Shunju advertisers, including Volkswagen, Mitsubishi, and Cartier. Within days, Bungei Shunju shut down Marco Polo and its editor, Kazuyoshi Hanada, quit, as did the president of Bungei Shunju, Kengo Tanaka.

1995

In Belgium, Holocaust denial was made illegal in 1995.

1996

In Turkey, in 1996, the Islamic preacher Harun Yahya distributed thousands of copies of a book which was originally published the previous year, entitled Soykırırm Yalanı (“The Holocaust Lie”) and mailed unsolicited texts to American and European schools and colleges. The publication of Soykırırm Yalanı sparked much public debate. This book claims, "what is presented as Holocaust is the death of some Jews due to the typhus plague during the war and the famine towards the end of the war caused by the defeat of the Germans." In March 1996, a Turkish painter and intellectual, Bedri Baykam, published a strongly worded critique of the book in the Ankara daily newspaper Siyah-Beyaz ("Black and White"). A legal suit for slander was brought against him. During the trial in September, Baykam exposed the real author of the book as Adnan Oktar. The suit was withdrawn in March 1997.

1996

The depiction of Jews in some of T.S. Eliot's poems has led several critics to accuse him of anti-Semitism. This case has been presented most forcefully in a study by Anthony Julius: T. S. Eliot, Anti-Semitism, and Literary Form (1996). In "Gerontion", Eliot writes, in the voice of the poem's elderly narrator, "And the jew squats on the window sill, the owner [of my building] / Spawned in some estaminet of Antwerp." Another well-known example appears in the poem, "Burbank with a Baedeker: Bleistein with a Cigar". In this poem, Eliot wrote, "The rats are underneath the piles. / The jew is underneath the lot. / Money in furs." Interpreting the line as an indirect comparison of Jews to rats, Julius writes, "The anti-Semitism is unmistakable. It reaches out like a clear signal to the reader." Julius's viewpoint has been supported by literary critics such as Harold Bloom, Christopher Ricks, George Steiner, Tom Paulin and James Fenton.

1997

This year the European Parliament, of which Jean-Marie Le Pen was then a member, removed his parliamentary immunity so that Le Pen could be tried by a German court for comments he made at a December 1996 press conference before the German Republikaner party. Echoing his 1987 remarks in France (see above), Le Pen stated: "If you take a 1,000-page book on World War II, the concentration camps take up only two pages and the gas chambers 10 to 15 lines. This is what one calls a detail." In June 1999, a Munich court found this statement to be "minimizing the Holocaust, which caused the deaths of six million Jews," and convicted and fined Le Pen for his remarks. Le Pen retorted ironically: "I understand now that it's the Second World War which is a detail of the history of the gas chambers."
1997

Jean-Marie Le Pen accused Jacques Chirac of being "on the payroll of Jewish organizations, and particularly of the B'nai B'rith."

1997

In Luxembourg, Article 457–3 of the Criminal Code, Act of 19 July 1997 outlaws Holocaust denial and denial of other genocides. The punishment is imprisonment for between 8 days and 6 months and/or a fine.

1998

In a May 1998 interview with ABC's John Miller, Osama bin Laden stated that the Israeli state's ultimate goal was to annex the Arabian Peninsula and the Middle East into its territory and enslave its peoples, as part of what he called a "Greater Israel". He stated that Jews and Muslims could never get along and that war was "inevitable" between them, and further accused the U.S. of stirring up anti-Islamic sentiment. He claimed that the U.S. State Department and U.S. Department of Defense were controlled by Jews, for the sole purpose of serving the Israeli state's goals.

1998

In a December 1998 interview with Pakistani journalist Rahimullah Yusufzai, Osama bin Laden stated that Operation Desert Fox was proof that Israeli Jews controlled the governments of the United States and United Kingdom, directing them to kill as many Muslims as they could.

1999

Holocaust Remembrance Day has been commemorated as a national remembrance day in Sweden every year since 1999.

1999

Intelligence Ministry of Iran arrested 13 Iranian Jews, accusing them of spying for Israel. Arrestees were five merchants, a rabbi, two university professors, three teachers in private Hebrew schools, a kosher butcher and a 16-year-old boy. Ten of them were sentenced to 4–13 years in prison. As a result of the pressure campaigns and secret negotiations, the prisoners were gradually freed in small groups. All of them emigrated to Israel with their families.

1999

Abraham Foxman of the Anti-Defamation League, in an 11 October 1999, letter to The Washington Post claimed that A Republic, Not an Empire by Pat Buchanan "defends Charles Lindbergh against charges of anti-Semitism, not mentioning the infamous 1940 [sic] speech in which he accused the Jews of warmongering." Pat Buchanan denies this and points out Foxman's error, saying that he mentioned the 1941 speech to say it "ignited a national firestorm," which lingered after the aviator's death, and shows "the explosiveness of mixing ethnic politics and foreign policy."
1999

Richard Baumhammers was arrested in Paris, France for striking a 50-year-old female bartender named Vivianne Le Garrac because he "believed she was Jewish". Baumhammers then told both Le Garrac and the arresting officers that he was "mentally ill." The police took Baumhammers to the psychiatric ward of the Hôtel-Dieu de Paris for evaluation, then detained him at a police station. By week's end, he left on a flight for Spain.

1999

There were arson attacks in Sacramento, California – Congregation B'nai Israel, Congregation Beth Shalom, and Knesset Israel Torah Center. The fires caused over $1 million in damage. On 17 March 2000, brothers Benjamin Matthew Williams and James Tyler Williams were charged with setting the three synagogue fires and a 2 July fire at the Country Club Medical center, which housed an abortion clinic. The charges carried up to 235 years in prison. Matthew Williams later admitted to reporters that he was one of eight or nine men who set fire to the synagogues and the clinic; he also claimed that his brother Tyler had not been involved.

1999 August 10

Buford O. Furrow, Jr, kills mail carrier Joseph Santos Ileto and shoots five people in the August 1999 Los Angeles Jewish Community Center shooting.

Twenty-first century

2000s

Craig Raine, in his books In Defence of T. S. Eliot (2001) and T. S. Eliot (2006), sought to defend Eliot from the charge of anti-Semitism. Reviewing the 2006 book, Paul Dean stated that he was not convinced by Raine's argument. Nevertheless, he concluded, "Ultimately, as both Raine and, to do him justice, Julius insist, however much Eliot may have been compromised as a person, as we all are in our several ways, his greatness as a poet remains." In another review of Raine's 2006 book, the literary critic Terry Eagleton also questioned the validity of Raine's defense of Eliot's character flaws as well as the entire basis for Raine's book, writing, "Why do critics feel a need to defend the authors they write on, like doting parents deaf to all criticism of their obnoxious children? Eliot's well-earned reputation [as a poet] is established beyond all doubt, and making him out to be as flawless as the Archangel Gabriel does him no favours."

2000

Richard Baumhammers walked to the home of his next-door neighbor, a 63-year-old Jewish woman named Anita "Nicki" Gordon and fatally shot her, then set her house on fire. Some time after that, he drove to the Beth El Congregation in Scott Township, where Gordon was a member of the synagogue. There, he fired into the windows of the synagogue, then exited his vehicle and spray-painted two red swastikas on the
building. Baumhammers later drove to the Ahavath Achim Congregation in Carnegie where he shattered the synagogue's glass windows with gunfire.

2000

In April 2000 the International League against Racism and Anti-Semitism and Union des étudiants juifs de France (the Union of French Jewish Students) brought a case against Yahoo! in which it objected to the auctioning of Nazi memorabilia, in France, via Yahoo!’s website on the basis that it contravened Article R645-1. Though a French judge initially ordered Yahoo! to take measures to make it impossible for users in France to purchase any Nazi memorabilia through the Yahoo! site, in December 2001, the US District Court for the Northern District of California ruled that Yahoo! would be shielded from the judgement of the French court.

2000

The Temple Beth El building, but not the sanctuary, was heavily damaged in an arson attack on 13 October 2000. Palestinian-American Ramsi Uthman was convicted in the attack. Ahed Shehadeh was convicted of aiding and abetting the arson. According to Shehadeh's testimony, after Uthman set fire to the Temple, he yelled "I did this for you, God!" In exchange for his testimony Shehadeh received a five-year prison sentence, and was released in 2008. Uthman received the maximum possible sentence of 25 years, to be served in New York's Attica Correctional Facility, although he will be eligible for parole in 2021. The building reopened in 2001 after repairing some $700,000 of damage from the attack.

2000

Firebombing of a New York synagogue (Conservative Synagogue Adath Israel of Riverdale), 2000 New York terror attack.

2000

The Canadian provinces of Alberta, Manitoba and Nova Scotia enacted legislation to recognize Holocaust Memorial Day in 2000.

2000 October 31

Beth Israel Synagogue (Edmonton) is firebombed.

2000

On 22 November 2000, Judge Edward R. Korman announced a settlement of the World Jewish Congress lawsuit against Swiss banks with his approval of a plan featuring the payment of $1.25 billion into funds controlled by the Israeli Banking Trust. Judah Gribetz was appointed Special Master to administer the plan, which is sometimes called the Gribetz Plan after its chief author.
David Irving v Penguin Books and Deborah Lipstadt is a case in English law, decided in 2000, against American author Deborah Lipstadt and her publisher Penguin Books, filed in an English court by the British author David Irving in 1996, asserting that Lipstadt had libeled him in her book Denying the Holocaust. The court ruled that the Irving's claim of libel relating to English defamation law and Holocaust denial was not valid because his deliberate distortion of evidence has been shown to be substantially true. English libel law puts the burden of proof on the defence, meaning that it was up to Lipstadt and her publisher to prove that her claims of Irving's deliberate misrepresentation of evidence to conform to his ideological viewpoints were substantially true. Lipstadt hired British-Jewish lawyer Anthony Julius while Penguin hired libel experts Kevin Bays and Mark Bateman of media law firm Davenport Lyons. Richard J. Evans, an established historian, was hired by the defence to serve as an expert witness. Evans spent two years examining Irving's work, and presented evidence of Irving's misrepresentations, including evidence that Irving had knowingly used forged documents as source material. Upon mutual agreement, the case was argued as a bench trial before Mr. Justice Charles Gray, who produced a written judgment 333 pages long in favour of the defendants, in which he detailed Irving's systematic distortion of the historical record of World War II.

2000

During the 2000 Presidential election, Lee Alcorn, president of the Dallas NAACP branch, criticized Al Gore's selection of Senator Joe Lieberman for his Vice-Presidential candidate because Lieberman was Jewish. On a gospel talk radio show on station KHVN, Alcorn stated, "If we get a Jew person, then what I'm wondering is, I mean, what is this movement for, you know? Does it have anything to do with the failed peace talks?" ... "So I think we need to be very suspicious of any kind of partnerships between the Jews at that kind of level because we know that their interest primarily has to do with money and these kind of things."

NAACP President Kweisi Mfume immediately suspended Alcorn and condemned his remarks. Mfume stated, "I strongly condemn those remarks. I find them to be repulsive, anti-Semitic, anti-NAACP and anti-American. Mr. Alcorn does not speak for the NAACP, its board, its staff or its membership. We are proud of our long-standing relationship with the Jewish community and I personally will not tolerate statements that run counter to the history and beliefs of the NAACP in that regard."

Alcorn, who had been suspended three times in the previous five years for misconduct, subsequently resigned from the NAACP and started his own organization called the Coalition for the Advancement of Civil Rights. Alcorn criticized the NAACP, saying, "I can't support the leadership of the NAACP. Large amounts of money are being given to them by large corporations that I have a problem with." Alcorn also said, "I cannot be bought. For this reason I gladly offer my resignation and my membership to the NAACP because I cannot work under these constraints."
Alcorn's remarks were also condemned by the Reverend Jesse Jackson, Jewish groups and George W. Bush's rival Republican presidential campaign. Jackson said he strongly supported Lieberman's addition to the Democratic ticket, saying, "When we live our faith, we live under the law. He [Lieberman] is a firewall of exemplary behavior."

Al Sharpton, another prominent African-American leader, said, "The appointment of Mr. Lieberman was to be welcomed as a positive step." The leaders of the American Jewish Congress praised the NAACP for its quick response, stating that: "It will take more than one bigot like Alcorn to shake the sense of fellowship of American Jews with the NAACP and black America... Our common concerns are too urgent, our history too long, our connection too sturdy, to let anything like this disturb our relationship."

2001
During the World Conference against Racism 2001, in Durban, two delegations, the United States and Israel, withdraw from the conference due to their objections to a draft document equating Zionism with racism.

2001
Every year since 2001, there has been an annual national memorial to the victims of the Holocaust in the United Kingdom.

2001
In Belgium in 2001, Roeland Raes, the ideologue and vice-president of one of the country's largest political parties, the Vlaams Belang (formerly named Vlaams Blok, Flemish Bloc), gave an interview on Dutch TV where he cast doubt over the number of Jews murdered by the Nazis during the Holocaust. In the same interview he questioned the scale of the Nazis' use of gas chambers and the authenticity of Anne Frank's diary. In response to the media assault following the interview, Raes was forced to resign his position but vowed to remain active within the party. Three years later, the Vlaams Blok was convicted of racism and chose to disband. Immediately afterwards, it legally reformed under the new name Vlaams Belang (Flemish Interest) with the same leaders and the same membership.

2001
Slovakia criminalized denial of fascist crimes in general in late 2001; in May 2005, the term "Holocaust" was explicitly adopted by the penal code and in 2009, it became illegal to deny any act regarded by an international criminal court as genocide.

2001
Untersturmführer Julius Viel was convicted in 2001 of shooting seven Jewish prisoners from the Theresienstadt concentration camp in 1945.

2001 May 4
At the 17th meeting of the International Liaison Committee in New York, Catholic Church officials state that they will change how Judaism is dealt with in Catholic seminaries and schools. In part, they state:

The curricula of Catholic seminaries and schools of theology should reflect the central importance of the Church’s new understanding of its relationship to Jews....Courses on Bible, developments by which both the Church and rabbinic Judaism emerged from early Judaism will establish a substantial foundation for ameliorating “the painful ignorance of the history and traditions of Judaism of which only negative aspects and often caricature seem to form part of the stock ideas of many Christians”.

...Courses dealing with the biblical, historical and theological aspects of relations between Jews and Christians should be an integral part of the seminary and theologate curriculum, and not merely electives. All who graduate from Catholic seminaries and theology schools should have studied the revolution in Catholic teaching on Jews and Judaism from Nostra aetate to the prayer of Pope John Paul II in Jerusalem at the Western Wall on 26 March 2000....For historic reasons, many Jews find it difficult to overcome generational memories of anti-Semitic oppression. Therefore: Lay and Religious Jewish leaders need to advocate and promote a program of education in our Jewish schools and seminaries – about the history of Catholic-Jewish relations and knowledge of Christianity and its relationship to Judaism....Encouragement of dialogue between the two faiths does involve recognition, understanding and respect for each other's beliefs, without having to accept them. It is particularly important that Jewish schools teach about the Second Vatican Council, and subsequent documents and attitudinal changes that opened new perspectives and possibilities for both faiths.

2002

In a letter released in late 2002, Osama Bin Laden stated that Jews controlled the civilian media outlets, politics, and economic institutions of the United States.

2002

In Romania, Emergency Ordinance No. 31 13 March 2002 prohibits Holocaust denial. It was ratified on 6 May 2006. The law also prohibits racist, fascist, xenophobic symbols, uniforms and gestures: proliferation of which is punishable with imprisonment from between six months to five years.

2002 March 11

Arson attack on Anshei Minsk Synagogue in Toronto, Ontario, Canada.

2002 March 30

2002 Lyon car attack takes place.

2002

During the Watergate affair, there were suggestions that Billy Graham had agreed with many of President Richard Nixon’s antisemitic opinions, but he denied them and stressed his efforts to build bridges
to the Jewish community. In 2002, the controversy was renewed when declassified "Richard Nixon tapes" confirmed remarks made by Graham to Nixon three decades earlier. Captured on the tapes, Graham agreed with Nixon that Jews control the American media, calling it a "stranglehold" during a 1972 conversation with Nixon, and suggesting that if Nixon was re-elected, they might be able to do something about it. When the tapes were made public, Graham apologized and said, "Although I have no memory of the occasion, I deeply regret comments I apparently made in an Oval Office conversation with President Nixon ... some 30 years ago. ... They do not reflect my views and I sincerely apologize for any offense caused by the remarks." According to Newsweek magazine, "[T]he shock of the revelation was magnified because of Graham's longtime support of Israel and his refusal to join in calls for conversion of the Jews."

2002

On 11 April, Ghriba synagogue bombing takes place in Tunisia.

2002

On 4 July 2002, a lone gunman opened fire at the airline ticket counter of El Al, Israel's national airline, at Los Angeles International Airport in Los Angeles, California. Two people were killed and four others were injured before the gunman was fatally shot by a security guard after also being wounded by him. This was the 2002 Los Angeles International Airport shooting.

2002

Pat Buchanan said

There was nothing immoral, or unwise, about the isolationists' position of 1940–41. Because of the courageous efforts of Lindbergh and America First, the United States stayed out of the war until Hitler threw the full force of his war machine against Stalin. Thus, the Soviet Union, not America’s young, bore the brunt of defeating Nazi Germany.

2002

In an interview for the magazine Lyon Capitale in January 2002, Dieudonné M'bala M'bala described "the Jews" as "a sect, a fraud, which is the worst of all, because it was the first" and said he preferred "the charisma of bin Laden to that of Bush".

2002

During a 2002 white supremacist terror plot, a pair of white supremacists planned to bomb a series of institutions and people associated with African American and American Jewish communities. Targets included the United States Holocaust Museum, the New England Holocaust Memorial; well-known Jews, including Steven Spielberg; and black leaders, including Rev. Jesse Jackson.
Massive European wave of attacks on Jews and Jewish institutions between March and May, with largest number of attacks occurring in France.

2002

In January 2002, the Canadian Human Rights Tribunal delivered a ruling in a complaint involving Holocaust denier Ernst Zündel's website, in which it was found to be contravening the Canadian Human Rights Act. The court ordered Zündel to cease communicating hate messages.

2003

Bulgaria officially designates 10 March as Holocaust Remembrance Day and the "Day of the Salvation of the Bulgarian Jews and of the Victims of the Holocaust and of the Crimes against Humanity".

2003 May 16

2003 Casablanca bombings target multiple locations, including a Jewish community center.

2003

The Southern Baptist Convention passed a resolution "On Anti-Semitism" stating in part:

"RESOLVED, That the messengers to the Southern Baptist Convention meeting in Phoenix, Arizona, June 17–18, 2003, denounce all forms of anti-Semitism as contrary to the teachings of our Messiah and an assault on the revelation of Holy Scripture; and be it further

"RESOLVED, That we affirm to Jewish people around the world that we stand with them against any harassment that violates our historic commitments to religious liberty and human dignity; and be it finally

"RESOLVED, That we call on governmental and religious leaders across the world to stand against all forms of bigotry, hatred, or persecution."

2003

People for the Ethical Treatment of Animals's "Holocaust on your Plate" exhibition consisted of eight 60-square-foot (5.6 m²) panels, each juxtaposing images of the Holocaust with images of factory-farmed animals. Photographs of concentration camp inmates were displayed next to photographs of battery chickens, and piled bodies of Holocaust victims next to a pile of pig carcasses. Captions alleged that "like the Jews murdered in concentration camps, animals are terrorized when they are housed in huge filthy warehouses and rounded up for shipment to slaughter. The leather sofa and handbag are the moral equivalent of the lampshades made from the skins of people killed in the death camps."

The exhibition was funded by an anonymous Jewish philanthropist, and created by Matt Prescott, who lost several relatives in the Holocaust. Prescott said: "The very same mindset that made the Holocaust possible – that we can do anything we want to those we decide are 'different or inferior' – is what allows us to
commit atrocities against animals every single day. ... The fact is, all animals feel pain, fear and loneliness. We're asking people to recognize that what Jews and others went through in the Holocaust is what animals go through every day in factory farms."

However, Abraham Foxman, chairman of the Anti-Defamation League, said the exhibition was "outrageous, offensive and takes chutzpah to new heights ... The effort by PETA to compare the deliberate systematic murder of millions of Jews to the issue of animal rights is abhorrent." Stuart Bender, legal counsel for the United States Holocaust Memorial Museum, wrote to PETA asking them to "cease and desist this reprehensible misuse of Holocaust materials."

On 20 February 2009, the German Federal Constitutional Court dismissed a legal move challenging an appeal court's ruling that PETA's campaign was not protected by free speech laws. While not entering formal proceedings to decide in the matter, the court expressed severe doubts as to whether the campaign constituted an offense against human rights in its opinion to dismiss the appeal, as had been found by the orderly courts, but acceded to the other grounds of the former rulings that the campaign constituted a trivialization of the Holocaust and hence a severe violation of living Jews' personality rights. The subtleties of the ruling are sometimes not reflected adequately in press reports.

2003

On Yom Ha'atzmaut 2003, a Molotov cocktail was thrown through one of the synagogue Valley Beth Shalom's stained-glass windows.

2003 October 16

The Malaysian Prime Minister Dr. Mahathir Mohammed draws a standing ovation at the 57-member Organisation of the Islamic Conference for his speech. An excerpt: "[Muslims] are actually very strong. 1.3 billion people cannot be simply wiped out. The Nazis killed 6 million Jews out of 12 million. But today the Jews rule this world by proxy. They get others to fight and die for them. They invented socialism, communism, human rights and democracy so that persecuting them would appear to be wrong so they may enjoy equal rights with others. With these they have now gained control of the most powerful countries. And they, this tiny community, have become a world power."

2003 November 16

Neve Shalom Synagogue was hit by one of four car bomb attacks carried out in Istanbul that week.

2004

Romania officially denied the Holocaust occurred on its territory up until the Wiesel Commission in 2004.

2004

National Holocaust Memorial Day has been recognized in Greece since 2004. Greek: Εθνική Ημέρα Μνήμης Ολοκαυτώματος (Ethniki Imera Mnimis Olokaftomatos), since 2004.
The film The Passion of The Christ was released in 2004. Before the film was even released, there were prominent criticisms of perceived antisemitic content in the film. 20th Century Fox told New York Assemblyman Dov Hikind they had passed on distributing the film in response to a protest outside the News Corporation building. Hikind warned other companies that "they should not distribute this film. This is unhealthy for Jews all over the world."

A joint committee of the Secretariat for Ecumenical and Inter-religious Affairs of the United States Conference of Catholic Bishops and the Department of Inter-religious Affairs of the Anti-Defamation League obtained a version of the script before it was released in theaters. They released a statement, calling it one of the most troublesome texts, relative to anti-Semitic potential, that any of us had seen in twenty-five years. It must be emphasized that the main storyline presented Jesus as having been relentlessly pursued by an evil cabal of Jews, headed by the high priest Caiaphas, who finally blackmailed a weak-kneed Pilate into putting Jesus to death. This is precisely the storyline that fueled centuries of anti-Semitism within Christian societies. This is also a storyline rejected by the Roman Catholic Church at Vatican II in its document Nostra aetate, and by nearly all mainline Protestant churches in parallel documents. ... Unless this basic storyline has been altered by Mr. Gibson, a fringe Catholic who is building his own church in the Los Angeles area and who apparently accepts neither the teachings of Vatican II nor modern biblical scholarship, The Passion of the Christ retains a real potential for undermining the repudiation of classical Christian anti-Semitism by the churches in the last forty years.

The ADL itself also released a statement about the yet-to-be-released film:

For filmmakers to do justice to the biblical accounts of the passion, they must complement their artistic vision with sound scholarship, which includes knowledge of how the passion accounts have been used historically to disparage and attack Jews and Judaism. Absent such scholarly and theological understanding, productions such as The Passion could likely falsify history and fuel the animus of those who hate Jews.

Rabbi Daniel Lapin, the head of the Toward Tradition organization, criticized this statement, and said of Foxman, the head of the ADL, "what he is saying is that the only way to escape the wrath of Foxman is to repudiate your faith".

In The Nation, reviewer Katha Pollitt said: "Gibson has violated just about every precept of the United States Conference of Catholic Bishops own 1988 'Criteria' for the portrayal of Jews in dramatizations of the Passion (no bloodthirsty Jews, no rabble, no use of Scripture that reinforces negative stereotypes of Jews, etc.) [...] The priests have big noses and gnarly faces, lumpish bodies, yellow teeth; Herod Antipas and his court are a bizarre collection of oily-haired, epigone perverts. The 'good Jews' look like Italian movie stars (Italian sex symbol Monica Bellucci is Mary Magdalene); Mary, who would have been around 50 and appeared 70, could pass for a ripe 35." Jesuit priest Fr. William Fulco, S.J., of Loyola Marymount
University—and the film's Hebrew dialogue translator—specifically disagreed with that assessment, and disagreed with concerns that the film accused the Jewish community of deicide.

One specific scene in the film perceived as an example of anti-Semitism was in the dialogue of Caiaphas, when he states "His blood [is] on us and on our children!", a quote historically interpreted by some as a curse taken upon by the Jewish people. Certain Jewish groups asked this be removed from the film. However, only the subtitles were removed; the original dialogue remains in the Hebrew soundtrack. When asked about this scene, Gibson said: "I wanted it in. My brother said I was wimping out if I didn't include it. But, man, if I included that in there, they'd be coming after me at my house. They'd come to kill me." In another interview when asked about the scene, he said, "It's one little passage, and I believe it, but I don't and never have believed it refers to Jews, and implicates them in any sort of curse. It's directed at all of us, all men who were there, and all that came after. His blood is on us, and that's what Jesus wanted. But I finally had to admit that one of the reasons I felt strongly about keeping it, aside from the fact it's true, is that I didn't want to let someone else dictate what could or couldn't be said."

Additionally, the film's suggestion that the Temple's destruction was a direct result of the Jews' actions towards Jesus could also be interpreted as an offensive take on an event which Jewish tradition views as a tragedy, and which is still mourned by many Jews today on the fast day of Tisha B'Av.

As one by Bill O'Reilly if his movie would "upset Jews", Gibson responded, "It's not meant to. I think it's meant to just tell the truth. I want to be as truthful as possible." In an interview in The Globe and Mail newspaper, he added: "If anyone has distorted Gospel passages to rationalize cruelty towards Jews or anyone, it's in defiance of repeated Papal condemnation. The Papacy has condemned racism in any form. ... Jesus died for the sins of all times, and I'll be the first on the line for culpability"

Conservative columnist Cal Thomas also disagreed with allegations of antisemitism, saying "To those in the Jewish community who worry that the film [...] might contain anti-Semitic elements, or encourage people to persecute Jews, fear not. The film does not indict Jews for the death of Jesus." Two Orthodox Jews, Rabbi Daniel Lapin and conservative talk-show host and author Michael Medved, also vocally rejected claims that the film is anti-Semitic. They have noted the film's many sympathetic portrayals of Jews: Simon of Cyrene (who helps Jesus carry the cross), Mary Magdalene, the Virgin Mary, St. Peter, St. John, Veronica (who wipes Jesus' face and offers him water) and several Jewish priests who protest Jesus' arrest (Nicodemus and Joseph of Arimathea) during Caiaphas' trial of Jesus.

Bob Smithouser of Plugged in Online believed that film was trying to convey the evils and sins of humanity rather than specifically targeting Jews, stating: "The anthropomorphic portrayal of Satan as a player in these events brilliantly pulls the proceedings into the supernatural realm—a fact that should have quelled the much-publicized cries of anti-Semitism since it shows a diabolical force at work beyond any political and religious agendas of the Jews and Romans."
Moreover, Senior Vatican officer Cardinal Darío Castrillón Hoyos, who has seen the film, addressed the matter so:

Anti-Semitism, like all forms of racism, distorts the truth in order to put a whole race of people in a bad light. This film does nothing of the sort. It draws out from the historical objectivity of the Gospel narratives sentiments of forgiveness, mercy, and reconciliation. It captures the subtleties and the horror of sin, as well as the gentle power of love and forgiveness, without making or insinuating blanket condemnations against one group. This film expressed the exact opposite, that learning from the example of Christ, there should never be any more violence against any other human being.

2004

The first National Day of Commemorating the Holocaust in Romania was held in 2004.

2004 April 4

United Talmud Torah school library is firebombed in Montreal, Quebec, Canada.

2004 May

Jewish organizations and leaders protest Estonia's erection of a statue commemorating Alfons Rebane, an Estonian SS volunteer accused of serving as a "a Nazi executioner" who was "responsible for the slaughter of thousands of Jews and Russians between 1941 and 1945."

2004 June

A series of attacks on Jewish cemeteries in Wellington, New Zealand.

2004 September

The European Commission against Racism and Intolerance, a part of the Council of Europe, called on its member nations to "ensure that criminal law in the field of combating racism covers anti-Semitism" and to penalize intentional acts of public incitement to violence, hatred or discrimination, public insults and defamation, threats against a person or group, and the expression of antisemitic ideologies. It urged member nations to "prosecute people who deny, trivialize or justify the Holocaust". The report was drawn up in wake of a rise in attacks on Jews in Europe. The report said it was Europe's "duty to remember the past by remaining vigilant and actively opposing any manifestations of racism, xenophobia, anti-Semitism and intolerance... Anti-Semitism is not a phenomenon of the past and... the slogan 'never again' is as relevant today as it was 60 years ago."

2005

The European Union has recognized International Holocaust Remembrance Day since 2005.
In 2005 the United States had a "moment of silence" on the 60th anniversary of the surrender of Nazi Germany.

2005

Dieudonné M'bala M'bala declared during a press conference in Algiers that the Central Council of French Jews CRIF (Conseil représentatif des institutions juives de France) was a "mafia" that had "total control over French policy exercise", called the commemoration of the Holocaust "memorial pornography" ("pornographie mémorielle"), and claimed that the "Zionists of the Centre National de la Cinématographie," which "control French cinema" prevented him from making a film about the slave trade. Dieudonné was also trying to appear as a spokesman for French blacks, but, after some initial sympathy, notably from the novelist Calixthe Beyala, the journalists Antoine Garnier and Claudy Siar, as well as the founding members of the Conseil représentatif des associations noires (CRAN), he increasingly met with their rejection.

2005

In 2005 the Egyptian Muslim Brotherhood leader, Mohammed Mahdi Akef, denounced what he called "the myth of the Holocaust" in defending Iranian president Mahmoud Ahmadinejad's denial of the Holocaust.

2005 September

Throughout the Polish election Radio Maryja continued to promote antisemitic views, including denial of the facts of the Jedwabne pogrom in 1941. Their support of right-wing conservative Law and Justice party is considered a major factor in their electoral victory.

2005

A group of 15 members of the State Duma of Russia demands that Judaism and Jewish organizations be banned from the country. In June, 500 prominent Russians demand that the state prosecutor investigate ancient Jewish texts as "anti-Russian" and ban Judaism. The investigation was launched, but halted among international outcry.

2005

The 2005 Los Angeles bomb plot was a 2005 effort by a group of ex-convicts calling themselves Jamîyyât Ul-Islam Is-Saheeh to bomb several military bases, a number of synagogues, and an Israeli consulate in California.

On 31 August 2005, Kevin James and three other men were indicted on terrorism charges related to conspiracy to attack military facilities in the Los Angeles area and of attempting to fund their campaign by robbing gas stations in Southern California over the previous three months. Kevin James, a Muslim convert, was accused of founding a radical Islamic group called J.I.S (Jam’îyyât Ul-Islam Is-
Saheeh (الصحيح الإسلامية جمعية), Arabic for "Assembly of Authentic Islam") from his cell in Folsom Prison in California, and of recruiting fellow inmates to join his mission to kill infidels.

2005

Prince Harry was photographed at Highgrove House at a "Colonial and Native" themed costume party wearing a Nazi German Afrika Korps uniform with a swastika armband. He later issued a public statement apologising for his behavior.

2005

International Holocaust Remembrance Day was designated by the United Nations General Assembly Resolution 60/7 on 1 November 2005 during the 42nd plenary session.

2005 December

Iranian president Mahmoud Ahmadinejad widens the hostility between Iran and Israel by denying the Holocaust during a speech in the Iranian city of Zahedan. He made the following comments on live television: "They have invented a myth that Jews were massacred and place this above God, religions and the prophets." Continuing, he suggested that if the Holocaust had occurred, that it was the responsibility of Europeans to offer up territory to Jews: "This is our proposal: give a part of your own land in Europe, the United States, Canada or Alaska to them [the Jews] so that the Jews can establish their country."

See Mahmoud Ahmadinejad and Israel

2006, 11 January

Alexandr Koptsev stabbbed nine people at Bolshaya Bronnaya Synagogue.

2006

On 11 December 2006, the Iranian state-sponsored "International Conference to Review the Global Vision of the Holocaust" opened to widespread condemnation. The conference, called for by and held at the behest of Ahmadinejad, was widely described as a "Holocaust denial conference" or a "meeting of Holocaust deniers", though Iran denied it was a Holocaust denial conference. A few months before it opened, the Iranian Foreign Ministry spokesman Hamid Reza Asefi stated: "The Holocaust is not a sacred issue that one can't touch. I have visited the Nazi camps in Eastern Europe. I think it is exaggerated."

2006

John Gudenus received a one-year suspended sentence for breaking the Verbotsgesetz, Austria's laws against denying or diminishing the Holocaust. Gudenus had suggested that it was necessary to verify the existence of gas chambers in Nazi Germany and later remarked that there had been gas chambers in Poland but not in Germany.
In 2006, Mel Gibson was arrested for driving under the influence (DUI) while speeding in his vehicle with an open container of alcohol, which is illegal in much of the United States. According to the arrest report, Gibson exploded into an angry tirade when the arresting officer would not allow him to drive home. Gibson climaxed with the words, "Fucking Jews... the Jews are responsible for all the wars in the world. Are you a Jew?"

2006

In 2006, sixty of Arthur Butz's colleagues from the Department of Electrical Engineering and Computer Science faculty signed a censure describing Butz's Holocaust denial as "an affront to our humanity and our standards as scholars". The letter also called for Butz to "leave our Department and our University and stop trading on our reputation for academic excellence".

2006

The Netherlands rejected a draft law proposing a maximum sentence of one year on denial of genocidal acts in general, although specifically denying the Holocaust remains a criminal offense there.

2006

Dieudonné M'bala M'bala was sentenced to a penalty of €4,500 for defamation after having called a prominent Jewish television presenter a "secret donor of the child-murdering Israeli army".

2006 February

A French Jew, Ilan Halimi is kidnapped and tortured to death for 23 days in what Paris police have officially declared an antisemitic act. The event causes international outcry. On 9 May, the Helsinki Commission held a briefing titled "Tools for Combating Anti-Semitism: Police Training and Holocaust Education".

2006 February

In February 2006 David Irving was convicted in Austria, where Holocaust denial is illegal, for a speech he had made in 1989 in which he denied the existence of gas chambers at Auschwitz. Irving was aware of the outstanding arrest warrant, but chose to go to Austria anyway "to give a lecture to a far-right student fraternity". Although he pleaded guilty to the charge, Irving said he had been "mistaken", and had changed his opinions on the Holocaust. "I said that then, based on my knowledge at the time, but by 1991 when I came across the Eichmann papers, I wasn't saying that anymore and I wouldn't say that now. The Nazis did murder millions of Jews." Irving served 13 months of a 3-year sentence in an Austrian prison, including the period between his arrest and conviction, and was deported in early 2007.

2006 July

Naveed Afzal Haq kills Pamela Waechter and injures five others in the July 2006 Seattle Jewish Federation shooting.
2006 December

The International Conference to Review the Global Vision of the Holocaust was a two-day conference that opened on 11 December 2006 in Tehran, Iran; many saw it as a conference rife with antisemitism, anti-Zionism, and Holocaust denial.

2007

Elie Wiesel was attacked in a San Francisco hotel by 22-year-old Holocaust denier Eric Hunt in February 2007, but was not injured. Hunt was arrested the following month and charged with multiple offenses.

2007

In May 2007 Ekrem Ajanovic, a Bosniak MP in the Bosnian Parliament proposed a legislation on criminalizing the denial of Holocaust, genocide and crimes against humanity. This was the first time that somebody in Bosnia and Herzegovina's Parliament proposed such a legislation. Bosnian Serb MPs voted against this legislation and proposed that such an issue should be resolved within the Criminal Code of Bosnia and Herzegovina. Following this, on 6 May 2009 Bosniak MPs Adem Huskic, Ekrem Ajanovic and Remzija Kadic proposed to the BH parliament a change to the Criminal Code of Bosnia and Herzegovina where Holocaust, genocide and crimes against humanity denial would be criminalized. Bosnian Serb MPs have repeatedly been against such a legislation claiming that the law "would cause disagreement and even animosity" according to SNSD member Lazar Prodanovic.

2007

In October 2007, a tribunal declared Spain's Holocaust denial law unconstitutional.

2007

On 15 November 2007, an appellate court sentenced Dieudonné M'bala M'bala to a €5,000 fine because he had characterized "the Jews" as "slave traders" after being attacked in le Théâtre de la Main d'Or.

2007

In 2007 Italy rejected a Holocaust denial law proposing a prison sentence of up to four years.

2007

A Jewish professor, Elizabeth Midlarsky, had a swastika spraypainted on her office door in 2007.

2007

On 15 February 2007, Holocaust denier Ernst Zündel was convicted on 14 counts of incitement under Germany's Volksverhetzung law, which bans the incitement of hatred against a portion of the population, and given the maximum sentence of five years in prison.

2007
On 7 July 2007, the Vatican released Pope Benedict XVI's motu proprio entitled, Summorum Pontificum which permitted more widespread celebration of Mass according to the "Missal promulgated by Pope John XXIII in 1962". Jewish reactions to the motu proprio underlined their concern that the traditional formulation of the Good Friday prayer for the Jews, which Jews felt offensive, would be more broadly used.

In the form in which they appear in the 1962 Missal, the set of prayers in which that of the Jews is included are for: the Holy Church, the Supreme Pontiff; all orders and grades of the faithful (clergy and laity); public officials (added in 1955, replacing an older prayer for the Holy Roman Emperor, not used since the abdication of Francis II in 1806 but still printed in the Roman Missal); catechumens; the needs of the faithful; heretics and schismatics; the conversion of the Jews (without the word "perfidis"); the conversion of pagans.

In later editions of the Missal, the prayers are for: the Church; the Pope, the clergy and laity of the Church; those preparing for baptism; the unity of Christians, the Jewish people; those who do not believe in Christ; those who do not believe in God; all in public office; those in special need.

2007 August/September

The Jewish state, Israel, is shocked to find a neo-Nazi group of immigrants (from Russia) called Patrol 36 committing vandalism and voicing anti-Semitic rhetoric within its borders. Some members had immigrated under the Law of Return. One of that group's members was a grandchild of a Holocaust survivor, and all were of Jewish descent. The group was violent against gays, Ethiopian Jews, haredi Jews, and drug addicts.

2007 and 2008

Pope Benedict XVI, via the document Summorum Pontificum, officially revives the Tridentine mass, which contains a Good Friday prayer asking for the conversion of the Jews. This leads to criticism from Jewish leaders, charging that the prayer is anti-Semitic. The Vatican subsequently issues a statement condemning anti-Semitism, but is reluctant to remove the prayer. and Benedict visits the Park East Synagogue in an April 2008 visit to New York, which is apparently well-received, with the congregants and the Pope exchanging gifts with each other.

Jewish communities around the world are rocked by firebombings, assaults, and death threats during a spate of Antisemitic incidents during the Gaza War.

2008

On 8 September 2009, the Harvard Crimson school paper ran a paid Holocaust denial ad from Bradley R Smith. It was quickly criticized and an apology was issued from the editor, claiming it was a mistake.
The Southern Baptist Convention passed a resolution stating in part, "RESOLVED, That we join in prayer for the peace of Jerusalem (Psalm 122:6-7), calling upon world leaders to renounce the growing tide of anti-Semitism".

2008

On 26 June 2008, Dieudonné M'bala M'bala was sentenced in the highest judicial instance to a €7,000 fine for his characterization of Holocaust commemorations as "memorial pornography".

2008


2008

On 26 December 2008, at an event at the Parc de la Villette in Paris, Dieudonné M'bala M'bala awarded the Holocaust denier Robert Faurisson an "insolent outcast" prize [prix de l'infréquentabilité et de l'insolence]. The award was presented by one of Dieudonné's assistants, Jacky, dressed in a concentration camp uniform with a yellow badge. This caused a scandal and earned him his sixth court conviction to date.

2008

The universal permission given to priests by Pope Benedict XVI in 2007 to celebrate (privately and, under certain conditions, even publicly) the Tridentine Mass as printed in the 1962 Roman Missal was followed by complaints from Jewish groups and some Catholic leaders over what they perceived as a return to a supersessionist theology that they saw expressed in the 1960 Good Friday prayer for the Jews. In response to the complaints, Pope Benedict amended the Good Friday prayer. On 6 February 2008, the Vatican newspaper, L'Osservatore Romano, published a note of the Secretariat of State announcing that Pope Benedict XVI had amended the Good Friday prayer for the Jews contained in the 1962 Roman Missal, and decreeing that the amended text "be used, beginning from the current year, in all celebrations of the Liturgy of Good Friday according to the aforementioned Missale Romanum".

The new prayer reads as follows:

Let us also pray for the Jews: That our God and Lord may illuminate their hearts, that they acknowledge Jesus Christ is the Savior of all men. (Let us pray. Kneel. Rise.) Almighty and eternal God, who want that all men be saved and come to the recognition of the truth, propitiously grant that even as the fullness of the peoples enters Thy Church, all Israel be saved. Through Christ Our Lord. Amen.

Even the new formulation met with reservations from groups such as the Anti-Defamation League. They considered the removal of "blindness" and "immersion in darkness" with respect to the Jews an improvement over the original language in the Tridentine Mass, but saw no reason why the prayer in the rite as revised by Paul VI was not used instead.
2008 26–29 November

Mumbai, India: Nariman House, a Chabad Lubavitch Jewish centre in Colaba known as the Mumbai Chabad House, was taken over by two Pakistani terrorists and several residents were held hostage. The house was stormed by NSG commandos and, after a long battle, the two attackers were killed. Rabbi Gavriel Holtzberg and his wife Rivka, who was six months pregnant, were murdered with other hostages inside the house by the attackers. Indian forces found the body of six hostages inside the house.

2009

Swedish television broadcast an interview recorded at the Society of St. Pius X’s seminary in Zaitzkofen, Bavaria. During the interview, Richard Williamson expressed a belief that Nazi Germany did not use gas chambers during the Holocaust and that a total of between 200,000 and 300,000 Jews were killed. Based upon these statements, the Bishop was immediately charged with and convicted of Holocaust denial by a German court. The Holy See declared that Pope Benedict had been unaware of Williamson’s views when he lifted the excommunication of four bishops including him, and that Williamson would remain suspended from his episcopal functions until he unequivocally and publicly distanced himself from his position on the Holocaust. In 2010 Williamson was convicted of incitement in a German court in relation to those views; the conviction was later vacated on appeal but then reinstated on retrial in early 2013. He appealed again, but his appeal was rejected.

2009

In August 2009, Hamas refused to allow Palestinian children to learn about the Holocaust, which it called "a lie invented by the Zionists" and referred to Holocaust education as a "war crime".

2009

On 27 February 2009, Dieudonné M'bala M'bala was ordered to pay 75,000 Canadian dollars in Montreal to singer and actor Patrick Bruel for defamatory statements. He had called Bruel a "liar" and an "Israeli soldier".

2009

On 26 March 2009, Dieudonné M'bala M'bala was fined €1,000 and ordered to pay €2,000 in damages for having defamed Elisabeth Schemla, a Jewish journalist who ran the now-defunct Proche-Orient.info website. He declared on 31 May 2005 that the website wanted to "eradicate Dieudonné from the audiovisual landscape" and had said of him that "he's an anti-Semite, he's the son of Hitler, he will exterminate everyone".

2009

On 27 October 2009, Dieudonné M'bala M'bala was sentenced to a fine of €10,000 for "public insult of people of Jewish faith or origin" related to his show with Robert Faurisson. Dieudonné appealed to the European Court of Human Rights, which rejected his case on 10 November 2015.
On 29 January 2009, Dieudonné M'bala M'bala celebrated the 80th birthday of Holocaust denier Robert Faurisson in his theater, in the midst of a representative gathering of Holocaust deniers, right-wing radicals, and radical Shiites.

Kevin Myers attracted criticism for a 2009 article for the Irish Independent in which he claims: "There was no holocaust (or Holocaust, as my computer software insists) and six million Jews were not murdered by the Third Reich. These two statements of mine are irrefutable truths". In the article, Myers criticises the 6-million figure – though he says "millions of Jews were murdered" – and criticises the term holocaust because "[m]ost Jewish victims of the Third Reich were not burnt in the ovens in Auschwitz. They were shot by the hundreds of thousands in the Lebensraum of the east, or were worked or starved to death in a hundred other camps, across the Reich." Overall, he states: "I'm a holocaust denier; but I also believe that the Nazis planned the extermination of the Jewish people, as far as their evil hands could reach."1

Tapes were released in which Billy Graham is heard in a 1973 conversation with Richard Nixon referring to Jews and "the synagogue of Satan". A spokesman for Graham said that Graham has never been an antisemite and that the comparison (in accord with the context of the quotation in the Book of Revelation) was directed specifically at those claiming to be Jews, but not holding to traditional Jewish values.

In a 14 April 2009, column, Pat Buchanan likened the persecution of John Demjanjuk to that of Jesus Christ on Calvary Hill, stating:

It is the same Satanic brew of hate and revenge that drove another innocent Man up Calvary that first Good Friday 2,000 years ago.

Members of the Lithuanian Jewish community report significant increases in anti-Semitism. Local Jewish leader Simonas Aperavicius notes anti-Semitism in the Lithuanian media.

On 20 May 2009, US law enforcement arrested four men in connection with a plot to shoot down military airplanes flying out of an Air National Guard base in Newburgh, New York, and blow up two synagogues in the Riverdale community of the Bronx. The group, led by James Cromitie, was tried and all four were convicted. It was later brought to light that the four men were actually encouraged into
participating in the plot by the FBI. The men argue that this was a case of entrapment. See 2009 Bronx terrorism plot.

2009 June


2010, 5 January

Etz Hayyim Synagogue was targeted for an arson attack.

2010, 21 February Sha'ar Hashamayim Synagogue (Cairo) bombed, no causalities.

2010, 23 July

Malmö Synagogue in Sweden is attacked with explosives. The explosion was caused with some kind of fireworks or firecracker containing too little gunpowder to seriously damage the building.

2010

In 2010 the Parliament of Hungary adopted legislation punishing the denial of the genocides committed by National Socialist or Communist systems, without mentioning the word "Holocaust".

2010

On 8 June 2010, Dieudonné M'bala M'bala was sentenced to a fine of €10,000 for defamation towards the International League against Racism and Anti-Semitism, which he had called "a mafia-like association that organizes censorship".

2011, 15 January

Congregation Dorshei Emet was one of six Jewish institutions in Montreal that were attacked by vandals on the night of 15 January 2011. The other buildings, all in Côte Saint-Luc, consisted of four synagogues and a school.

2011

In 2011, the first man was charged with Holocaust denial in Budapest. The Court sentenced the man to 18 months in prison, suspended for three years, and probation. He also had to visit either Budapest's memorial museum, Auschwitz or Yad Vashem in Jerusalem. He chose his local Holocaust Memorial Center and had to make three visits in total and record his observations.

2011

In 2011, J. Z. Knight stated, among other things, "Fuck God's chosen people! I think they have earned enough cash to have paid their way out of the goddamned gas chambers by now."
The 2011 Manhattan terrorism plot was a conspiracy by two Muslim Arab-Americans to bomb various targets in the Manhattan borough of New York City, New York, USA. They had planned to attack an unspecified synagogue and one of them expressed interest in blowing up a church and the Empire State Building. New York City law enforcement arrested the two suspects, 26-year-old Ahmed Ferhani and 20-year-old Mohamed Mamdouh, in a sting operation on 11 May 2011. Their plot was motivated primarily by "hatred of infidels and anti-semitism" according to the authorities.

After the town of Wunsiedel became the scene of pilgrimages and neo-Nazi demonstrations every August on the date of Rudolf Hess's death, the parish council decided not to allow an extension on the grave site's lease when it expired in 2011. With the eventual consent of his family, Hess's grave was re-opened on 20 July 2011 and his remains were exhumed, and then cremated. His ashes were scattered at sea by family members; the gravestone, which bore the epitaph "Ich hab's gewagt" ("I have dared"), was destroyed.

Mohammed Merah, a 23-year-old Algerian Muslim kills four Jews (including three children) outside a school in Toulouse, France.

Jew Pond, a small body of water in Mont Vernon, New Hampshire, is officially renamed Carleton Pond.

Section 335 of the Act C of 2012 on the Criminal Code of Hungary regulates the "use of symbols of totalitarianism", including the swastika, the insignia of the SS, the arrow cross, the hammer and sickle, and the five-pointed red star.

In February 2012, a member of The Church of Jesus Christ of Latter-day Saints performed a posthumous baptism for Simon Wiesenthal's parents without proper authorization. After his own name was submitted for proxy baptism, Elie Wiesel spoke out against the unauthorized practice of posthumously baptizing Jews and asked presidential candidate and Latter-day Saint Mitt Romney to denounce it. Romney's campaign declined to comment, directing such questions to church officials.

Malmö Synagogue in Sweden is attacked with an explosive device on 28 September 2012, shattering a window.
In an interview with CNN, newly elected Iranian President Hassan Rouhani was quoted as condemning the Holocaust, stating, "I can tell you that any crime that happens in history against humanity, including the crime the Nazis created towards the Jews as well as non-Jews is reprehensible and condemnable. Whatever criminality they committed against the Jews, we condemn." Iranian media later accused CNN of fabricating Rouhani's comments.

2013

Alice Walker expressed appreciation for the works of the conspiracy theorist David Icke. On BBC Radio 4's Desert Island Discs, she said that Icke's book Human Race Get Off Your Knees would be her choice if she could have only one book. The book promotes the theory that the Earth is ruled by shapeshifting reptilian humanoids and "Rothschild Zionists." Jonathan Kay of the National Post described the book as "hateful, hallucinogenic nonsense." He wrote that Walker's public praise for Icke's book was "stunningly offensive" and that by taking it seriously, she was disqualifying herself "from the mainstream marketplace of ideas."

2013

In December, while performing onstage, Dieudonné M'bala M'bala was recorded saying about prominent French Jewish radio journalist Patrick Cohen: "Me, you see, when I hear Patrick Cohen speak, I think to myself: ‘Gas chambers... too bad.'"

2013

On 31 December, Dieudonné M'bala M'bala released a 15-minute video proposing that “2014 will be the year of the quenelle!". In it, Dieudonné attacks "bankers" and "slavers", so as not to say "Jews" and end up in a lawsuit, and calls upon his followers, "quenelleurs"—those who listen and follow him—towards a hatred of Jews.

2013

Louis Farrakhan made antisemitic comments during his 16–17 May 2013 visit to Detroit and in his weekly sermons titled "The Time and What Must Be Done", begun during January 2013.

2013

In his official 2013 Nowruz address, Supreme Leader of Iran Grand Ayatollah Ali Khamenei questioned the veracity of the Holocaust, remarking that "The Holocaust is an event whose reality is uncertain and if it has happened, it's uncertain how it has happened." This was consistent with Khamenei's previous comments regarding the holocaust.

2014

On 6 January, France's interior minister Manuel Valls said that performances considered anti-Semitic may be banned by local officials. Within hours, Bordeaux became the first French city to ban Dieudonné M'bala
M'bala when mayor Alain Juppé canceled a local appearance planned as part of a scheduled national tour, followed closely by Nantes, Tours, Orleans, Toulouse, Limoges, and Biarritz. The show in Switzerland will go on as scheduled, while other cities are still studying the situation. The Paris Prefect of Police on 10 January prohibited Dieudonné from staging his next three upcoming shows at his Paris theatre. In February, Dieudonné was banned from entry in the United Kingdom.

2014 April 13

Antisemitic Ku Klux Klan leader Frazier Glenn Cross, also known as Frazier Glenn Miller, kills three non-Jewish people at a Jewish community center and a Jewish retirement in home in Overland Park, Kansas, the day before the start of Passover.

2014 May

Residents of a village in Spain called Castrillo Matajudíos ("Jew-killer Camp") since 1627 vote to change the name of the village to the older name Castrillo Mota de Judíos ("Hill of Jews Camp"). The name is changed in June 2015.

2015

The Mayors United Against Antisemitism initiative was developed by the American Jewish Committee in July 2015 and launched in Europe later in 2015. [183]

2015

The Porte de Vincennes siege occurred at a Hypercacher kosher superette in Porte de Vincennes (20th arrondissement of Paris) in the wake of the Charlie Hebdo shooting two days earlier, and concurrently with the Dammartin-en-Goële hostage crisis in which the two Charlie Hebdo gunmen were cornered. Amedy Coulibaly had pledged allegiance to the Islamic State of Iraq and the Levant, and was a close friend of Saïd Kouachi and Chérif Kouachi (whom he had met in jail in 2005), the gunmen in the Charlie Hebdo attack. Armed with a submachine gun, an assault rifle, and two Tokarev pistols, he entered and attacked the people in the kosher food superette. He had a female accomplice, speculated to be his wife, Hayat Boumeddiene. Coulibaly murdered four Jewish hostages, and held fifteen other hostages during a siege in which he demanded that the Kouachi brothers not be harmed. The police ended the siege by storming the store and killing Coulibaly.

2015

On 10 January 2015, following the Charlie Hebdo shooting, the Porte de Vincennes siege of a kosher supermarket, and the 1,500,000-strong "march against hatred" in Paris, Dieudonné M'bala M'bala wrote on Facebook "As far as I am concerned, I feel I am Charlie Coulibaly." In this way he mixed the popular slogan "Je suis Charlie", used to support the journalists killed at the Charlie Hebdo magazine, with a reference to Amedy Coulibaly who was responsible for the hostage-taking at the kosher supermarket which
included the killing of four Jews. On 13 January, Dieudonné was arrested in Paris, accused of publicly supporting terrorism, based on his earlier Facebook comments where he appeared to support the kosher supermarket gunman Amedy Coulibaly. Dieudonné’s arrest over his “Je suis Charlie Coulibaly” comments sparked discussion over a perceived hypocrisy concerning freedom of speech, contrasting his bans and arrest, with the freedom for Charlie Hebdo to publish controversial cartoons of Muhammad.

2015 February 3

2015 Nice stabbing three soldiers, guarding a Jewish community center in Nice, France, were attacked with a knife by Moussa Coulibaly, a lone-wolf terrorist.

2015

In 2015, the House of Cartoon and the Sarcheshmeh Cultural Complex in Iran organized the International Holocaust Cartoon Competition, a competition in which artists were encouraged to submit cartoons on the theme of Holocaust denial. Hamshahri, a popular Iranian newspaper, held a similar contest in 2006.

2015

Within hours of his being announced as Jon Stewart’s successor, attention was drawn on the Internet to several jokes that Trevor Noah had made through his Twitter account, which were criticized as being offensive to women and Jews, and to be making fun of the Holocaust. Noah responded by tweeting, "To reduce my views to a handful of jokes that didn't land is not a true reflection of my character, nor my evolution as a comedian." Comedy Central stood behind Noah, saying in a statement, "Like many comedians, Trevor Noah pushes boundaries; he is provocative and spares no one, himself included... To judge him or his comedy based on a handful of jokes is unfair. Trevor is a talented comedian with a bright future at Comedy Central." Mary Kluk, chairperson of the South African Jewish Board of Deputies (SAJBD), said that the jokes were not signs of anti-Jewish prejudice and that they were part of Noah’s style of comedy.

2015

In March 2015, Louis Farrakhan accused Jews of involvement in the September 11 attacks.

2015

In June 2015 Laurent Louis got a suspended 6-month sentence for breaking the 1995 Belgian law against Holocaust denial and lost his right to run for office in the next six years. He filed an appeal. Louis was ordered by the Belgian court of appeal in 2017, in lieu of a sentence and fine, to visit one Nazi concentration camp a year for the next five years.

January 2015

In January 2015, the Hungarian court ordered far-right on-line newspaper Kuruc.info to delete its article denying the Holocaust published in July 2013, which was the first ruling in Hungary of its kind. The
Association for Civil Liberties (TASZ) offered free legal aid to the website as a protest against restrictions on freedom of speech, but the site refused citing the liberal views of the association, and also refused to delete the article.

January 2015
Spray-painted swastikas were drawn on the outside wall of a Jewish fraternity at U.C. Davis, on the 70th anniversary of the liberation of Auschwitz from the Nazis.

January 2015
La Mort aux Juifs was a hamlet under the jurisdiction of the French commune of Courtemaux in the Loiret department in north-central France. Its name has been translated as "Death to Jews" or "The death of the Jews". Under pressure from the national authorities, the municipal council retired the name in January 2015. A similar request about the name had been denied in 1992. The area is now split between the nearby hamlets of Les Croisilles and La Dogetterie.

2015 January 10
French terrorist Amedy Coulibaly takes hostages in a kosher supermarket in Paris in the course of the Charlie Hebdo shooting. He claims in the media that he wanted to kill Jews.

2015 February 14–15
2015 Copenhagen shootings

2015 February 16
Israel's PM Benjamin Netanyahu causes outrage by calling for a massive immigration of Jewish people from Europe to Israel saying "we say to the Jews, to our brothers and sisters, Israel is your home and that of every Jew." French PM Manuel Valls replied by saying "the place for French Jews is France."

2015 March
Stanford University student senate candidate Molly Horwitz was asked by a student group how her Jewish faith would affect her decision-making.

2015 August
Two Jewish synagogues and a Jewish neighborhood on the North Side of San Antonio, Texas, are vandalized with anti-Semitic graffiti.

2015 October
The Catholic Church in Poland publishes a letter referring to antisemitism as a sin against the commandment to love one's neighbor. The letter also acknowledged the heroism of those Poles who risked their lives to shelter Jews as Nazi Germany carried out the Holocaust in occupied Poland. The bishops who
signed the letter cited the Polish Pope John Paul II who was opposed to antisemitism, and believed in founding Catholic-Jewish relations.

2015 October

Facebook has been accused of being a public platform used to incite terrorism. In October 2015, 20,000 Israelis claimed that Facebook was ignoring Palestinian incitement on its platform and filed a class-action suit demanding that Facebook remove all posts "containing incitement to murder Jews".

2015 December

The Vatican releases a 10,000-word document that, among other things, states that Jews do not need to be converted to find salvation, and that Catholics should work with Jews to fight antisemitism.

2015 December

The United Nations officially recognizes Yom Kippur, stating that from then on no official meetings will take place on the day. As well, the United Nations states that, beginning in 2016, they will have nine official holidays and seven floating holidays which each employee will be able to choose one of. It stated that the floating holidays will be Yom Kippur, Day of Vesak, Diwali, Gurpurab, Orthodox Christmas, Orthodox Good Friday, and Presidents' Day. This is the first time the United Nations officially recognizes any Jewish holiday.

2016

Natasha Waldorf of Alameda, who was Jewish, was subjected to two boys sending her text messages that included the word "kike" and other anti-Semitic insults, and the picture of product mascot Mr. Clean in a Nazi uniform called "Mr. Ethnic Cleansing." Two other students joked about the Holocaust and, when she confronted them, told her that "Hitler should have finished the job."

2016

Amidst an ongoing controversy in the Labour Party about antisemitism, Naz Shah was discovered by blogger Paul Staines in April 2016 to have reposted a Facebook meme in August 2014 supporting the relocation of Israel to the USA. Shah also commented on the post, suggesting the plan might "save them some pocket money". In July 2014, she wrote on Facebook about a newspaper poll concerning alleged Israeli war crimes in the Gaza conflict that "The Jews are rallying to the poll" and in September appeared to compare Israeli policies to those of Adolf Hitler. Shah asserted that her views on Israel had moderated in the 20 months since the post and on 26 April 2016 she resigned from her unpaid post as John McDonnell's PPS while still holding her seat on the Home Affairs Select Committee investigating the rise of antisemitism in the UK. She was suspended by the Labour Party on 27 April 2016, forfeiting all roles.
In April 2016, Ken Livingstone commented publicly on the suspension of Labour MP Naz Shah; she had been removed from the party after it was revealed that she had made comments on Facebook suggesting that Israeli Jews should be relocated to the United States. Livingstone stated that Shah's postings, which were made before she became an MP at the 2015 general election, were "completely over the top" and "rude", although he did not deem them antisemitic. He asserted that there is a "well-orchestrated campaign by the Israel lobby to smear anybody who criticises Israeli policy as antisemitic", and also stated that Adolf Hitler "was supporting Zionism before he went mad and ended up killing six million Jews".

He defended his claims by reference to Lenni Brenner's Zionism in the Age of the Dictators, and many commentators suggested that Livingstone was referring to the Haavara Agreement between Nazi Germany and the Zionist Federation of Germany. Livingstone's statements were criticised by historians, among them Roger Moorhouse, who said that they were historically inaccurate. He also became involved in a public argument on the subject with the Labour MP John Mann.

Livingstone was subsequently suspended from Labour Party membership "for bringing the party into disrepute". Over 20 Labour MPs called for Livingstone's suspension, while Jon Lansman, founder of the pro-Corbyn Momentum group, called for Livingstone to leave politics altogether, and Khan called for his expulsion from the party. In a subsequent interview, Livingstone expressed regret both for mentioning Hitler and for offending Jews but added that "I'm not going to apologise for telling the truth." Corbyn announced that the decision to expel Livingstone would be made by a National Executive Committee internal inquiry, whilst Livingstone insisted that he would be exonerated on the basis of Brenner's book, saying "how can the truth be an offence?" Following this controversy, Livingstone has questioned whether or not he has Jewish ancestry on his mother's side stating that Greville Janner used to speculate whether or not he was Jewish because "my grandmother's name was Zona."

Livingstone was sacked in Spring 2016 by LBC. He was quoted by The Daily Telegraph as saying this was because of his comments about Hitler.

2016

The U.C. Board of Regents approved a set of Principles Against Intolerance, which condemns "anti-Semitism" and which, in an opening contextual statement, includes "anti-Semitic forms of anti-Zionism" as something that has "no place at the University of California." The principles, passed unanimously at a 23 March board meeting in San Francisco, apply to students and faculty at all 10 U.C. campuses, though the document includes no enforcement mechanism or consequences for violations.

2016

An ethics rule of the American Bar Association now forbids comments or actions that single out someone on the basis of religion, as well as other factors.
Richard B. Spencer and his organization drew considerable media attention in the weeks following the 2016 presidential election, where, in response to his cry "Hail Trump, hail our people, hail victory!", a number of his supporters gave the Nazi salute similar to the Sieg Heil chant used at the Nazis' mass rallies. Spencer has defended their conduct, stating that the Nazi salute was given in a spirit of "irony and exuberance".

2016

The campus chapter of Students for Justice in Palestine at the University of California, Irvine was sanctioned because they disrupted a program hosted by a Jewish campus group in May and intimidated Jewish students.

2016

Ted Nugent posted an image on his Facebook page implying that Jews were responsible for gun control. Nugent's antisemitic rant sparked outrage and gun owners called for his NRA resignation.

2016

The nations that make up the Organization for Security and Cooperation in Europe began a three-year initiative to promote awareness and learning about anti-Semitism and to help the security of Jewish communities.

2016

On 13 November 2016, Steve Bannon, formerly the executive chair of Breitbart News, was appointed chief strategist and senior counselor to President-elect Donald Trump. This appointment drew opposition from the Anti-Defamation League, the Council on American–Islamic Relations, the Southern Poverty Law Center, Democrat Senate Minority Leader Harry Reid, and some Republican strategists, because of statements in Breitbart News that were alleged to be racist or anti-Semitic.

Ben Shapiro, Bernard Marcus of the Republican Jewish Coalition, Morton Klein and the Zionist Organization of America, Pamela Geller, Shmuley Boteach, and David Horowitz defended Bannon against the allegations of antisemitism. Alan Dershowitz first defended Bannon and said there was no evidence he was anti-semitic, but in a later piece stated that Bannon and Breitbart had made bigoted statements against Muslims, women, and others. The ADL said "we are not aware of any anti-Semitic statements from Bannon", while adding "under his stewardship, Breitbart has emerged as the leading source for the extreme views of a vocal minority who peddle bigotry and promote hate." Shapiro, who previously worked for Breitbart, said that he has no evidence of Bannon being racist or an anti-Semite, but that he was "happy to pander to those people and make common cause with them in order to transform conservatism into European far-right nationalist populism", an assertion supported by other sources and his alluding to Front National politician Marion Maréchal-Le Pen as "the new rising star".

2016
In December 2016, the neo-Nazi and white supremacist website The Daily Stormer published a list of six local Jews in Whitefish, Montana along with their personal information, claiming that they were harming the business of Richard Spencer’s mother and asking readers to “take action” against them. Whitefish police increased local patrols, and monitored Internet activity; Montana politicians and community groups responded with various efforts to focus attention on the question of antisemitism. On 28 Dec. 2016, Spencer indicated that he did not want to bring ongoing national attention to Whitefish with his political views, and an offer was made to call off a proposed armed march against Jews, Jewish businesses and people who support either in the town. The march was postponed because the proper permitting materials were not submitted and the required fee was not paid.

2017

The court of appeal of Liège confirmed a first instance sentence of two months of jail time and a 9.000 euros fine for Dieudonné M'bala M'bala’s anti-Semitic remarks in a performance on Herstal on 14 March 2012.

2017

In 2017, Alice Walker published a poem on her blog entitled "It Is Our (Frightful) Duty to Study the Talmud", recommending that the reader should start with YouTube to learn about the evils of the Talmud.

2017

With the beginning of the year, a wave of threats, including bomb threats, were made against Jewish Community Centers and other Jewish institutions in the United States. Juan M. Thompson, an African American former journalist for The Intercept, was arrested and charged with making at least eight of the hoax threats, as well as a threat made against the Anti-Defamation League, while allegedly impersonating a former girlfriend. Another suspect, an unidentified 19-year-old Israeli-American man, was arrested in Ashkelon, Israel and charged with responsibility for "dozens" of the threats.

2017

Brutal Murder of Sarah Halimi in Paris 4 April 2017. The murderer is a Muslim migrant from Mali, commenced a typical hate crime, crying "Allahu Abkar", mentioning his victim's ethnicity and religion but pretended to be mad and still hidden in psychology hospital instead of prison.

2017

Sebastian Gorka appeared on Fox News on the evening of the U.S. presidential inauguration wearing a badge, tunic, and ring associated with Order of Vitéz. According to some sources, Gorka was a member of the Order of Vitéz by inheritance, a group the US State Department lists as a Nazi-linked group. This has given rise to claims that Gorka himself carries sympathy for the Nazis. His father, Paul Gorka, was never a member of this Order and received a "Vitéz" (literally: "Valiant") medal from Hungarian exiles "for his resistance to dictatorship" in 1979. Gorka himself stated that he wears this medal in remembrance of his
father, who was awarded the decoration for his efforts to create an anti-Communist, pro-democracy organization at the university he attended in Hungary. Robert Kerepeszki, Hungarian expert of the Order of Vitéz, has confirmed that there were ruptures in the organization of the Order of Vitéz on the question of Nazism during the war, many of them died fighting against Hungarian Nazis, and Gorka's medal had nothing to do with the war period, but was awarded "for his resistance to dictatorship."

2017

Leaders of one of two successor organisations of the Vitézi Rend stated that Sebastian Gorka was an official member of the Historical Vitézi Rend faction, to which he is said to have taken a lifelong oath of loyalty. Gorka denied the allegations. The Anne Frank Center for Mutual Respect, the National Jewish Democratic Council, and the Interfaith Alliance have called for Gorka's resignation over his ties to Hungarian far-right groups. The Anti-Defamation League has asked Gorka to disavow the Hungarian far-right groups that he has been associated with. Democratic Senators Ben Cardin, Dick Durbin and Richard Blumenthal sent a letter to the Department of Justice and the Department of Homeland Security requesting that the DHS look into whether Gorka "illegally procured his citizenship" by omitting membership in Historical Vitézi Rend, which could have been grounds for keeping him out of the country.

2017

Chicago Dyke March organizers singled out and approached a group of women carrying Jewish pride flags and began questioning them on their political stance in regards to Zionism and Israel, and then after a discussion asked them to leave the event, insisting that their presence "made people feel unsafe". The organizers attributed the responses of the women and the white star of David, featured at the center of the rainbow flag as a "zionist expression". This prompted widespread accusations of antisemitism.

2017

In the early morning hours of 28 June 2017, one of the 9 feet (2.7 m) glass panels on the New England Holocaust Memorial was smashed with a rock.

2017

In Ukraine, some men vandalized the Space of Synagogues [Holocaust] memorial display; they wrote neo-Nazi slogans and the English words "white power", and drew a swastika and ultranationalist Ukrainian symbols.

2017

Viktor Orbán, Prime Minister of Hungary, made a speech in which he called Miklós Horthy an "exceptional statesman" and gave him the credit for the survival of Hungary. The U.S. Holocaust Museum then issued a statement denouncing Orbán and the Hungarian government for trying to "rehabilitate the reputation of Hungary's wartime leader, Miklos Horthy, who was a vocal anti-Semite and complicit in the murder of the country's Jewish population during the Holocaust."
2017

The BBC removed a line from one of its online articles which had offended Jews and Muslims; the line had stated, "The Holocaust is a sensitive topic for many Muslims because Jewish survivors settled in British-mandate Palestine, on land which later became the state of Israel."

2017

Antisemitic fliers were circulated around Lakewood, New Jersey.

2017

An antisemitic banner was found in front of a Holocaust memorial at a synagogue in Lakewood, New Jersey.

2017

Fliers were found around Little Italy saying among other things, "We are killing off the entire white race by making them addicted to cocaine, crack, meth, spiked marijuana, ecstasy, spice, heroine, hash and other poisons, Adolph Hitler's [sic] Nazi's [sic] killed off six million ugly Jews by telling them to go into showers to get cleaned up for their new lives, then they locked the shower doors and poisoned them all to death with a deadly gas, and finally they grabbed all of the dead Jew's properties."

2017

The chairpersons of Chicago SlutWalk wrote, "We still stand behind Dyke March Chicago's decision to remove the Zionist contingent from their event, & we won't allow Zionist displays at ours", referring to a then-upcoming demonstration of theirs. The Chicago SlutWalk's organizers made the following declaration about the Star of David, "its connections to the oppression enacted by Israel is too strong for it to be neutral & IN CONTEXT [at the Dyke March Chicago event] it was used as a Zionist symbol."

2017

A resolution was passed by the San Francisco Board of Supervisors against "verbal and violent anti-Semitic assaults, both nationally and in the Bay Area"; the resolution also contained a promise to "stand in solidarity with Jewish and other communities whenever they are targeted or marginalized."

2017

A Jewish cemetery in St. Louis, Missouri was vandalized in an apparent anti-Semitic incident in February 2017, after which Linda Sarsour worked with other Muslim activists to launch a crowdfunding campaign to raise money to repair the damage and restore the gravesites. More than $125,000 was raised, and Sarsour pledged to donate any funds not needed at the cemetery to other Jewish community centers or sites targeted by vandalism. She said the fundraising effort would "send a united message from the Jewish and Muslim communities that there is no place for this type of hate, desecration, and violence in America". St. Louis's United Hebrew Congregation Senior Rabbi, Brigitte S. Rosenberg, whose congregants had family
members buried in the vandalized cemetery, called the campaign "a beautiful gesture". However, the project generated some controversy as the funds were not distributed as quickly as some had expected. In 2018, Alzado Harris confessed to the desecration.

2017

Imam Sheikh Ammar Shahin gave an anti-semitic sermon at the Islamic Center of Davis, but apologized for it a few days later.

2017

At the end of July 2017, Kevin Myers contributed an article entitled "Sorry, ladies - equal pay has to be earned" to the Irish edition of The Sunday Times about the lower income of female presenters working for the BBC, after it was reported that two thirds of the BBC's top paid stars were men and only one of its top ten best paid presenters is a woman. He speculated: "Is it because men are more charismatic performers? Because they work harder? Because they are more driven? Possibly a bit of each" and that men might be paid more because they "work harder, get sick less frequently and seldom get pregnant". Myers further alleged that Claudia Winkleman and Vanessa Feltz are higher paid than other female presenters because they are Jewish. He wrote: "Jews are not generally noted for their insistence on selling their talent for the lowest possible price, which is the most useful measure there is of inveterate, lost-with-all-hands stupidity". The editor of the Irish edition, Frank Fitzgibbon, issued a statement saying in part "This newspaper abhors anti-Semitism and did not intend to cause offence to Jewish people". Martin Ivens, editor of The Sunday Times, said the article should not have been published. Ivens and Fitzgibbon apologised for publishing it. After complaints from readers and the Campaign Against Antisemitism, the article was removed from the website. It has been announced by the newspaper that Myers will not write for The Sunday Times again. Myers was defended by the chair of the Jewish Representative Council of Ireland, Maurice Cohen, who said that Myers was not antisemitic, but had rather "inadvertently stumbled into an antisemitic trope. ... Branding Kevin Myers as either an antisemite or a Holocaust denier is an absolute distortion of the facts." Myers apologised for this article on radio, saying that "it is over for me professionally as far as I can see", and that "I think they [Jewish people] are the most gifted people who have ever existed on this planet and civilisation owes an enormous debt to them – I am very, very sorry that I should have so offended them."

2017

The Unite the Right rally was a gathering of far-right groups in Charlottesville, Virginia, United States, on 11 and 12 August 2017.

On the evening of Friday, 11 August, a group of white nationalists—variously numbered at dozens, around 100, and hundreds —marched through the University of Virginia's campus while chanting things including "Jews will not replace us", and the Nazi slogan "Blood and Soil". On 12 August protesters and counterprotesters gathered at Emancipation Park (formerly known as Lee Park). White nationalist protesters chanted Nazi-era
slogans, including "Blood and Soil". They shouted among other things, "Jews will not replace us." Some held posters targeting Jews that read "the Goyim know", using the Hebrew word for non-Jews, as well as "the Jewish media is going down". Also on 12 August, an attendee drove his car into a crowd of people protesting the rally, killing 32-year-old Heather D. Heyer and injuring 19 others, in what police have called a deliberate attack. The driver was identified as James Alex Fields Jr.; following the crash, his former high school history teacher said he was a Nazi sympathizer who held white supremacist views and was infatuated with Adolf Hitler. Two hours before the crash, a New York Daily News photographer snapped James brandishing a wooden shield emblazoned with the logo for neo-Nazi group Vanguard America, standing alongside its members. However, after he was arrested, the group issued a statement denying he was a member and saying "the shields were freely handed out to anyone in attendance."

2017

Several internet companies, such as domain registrar GoDaddy and video game chat application Discord, shut down services for neo-Nazi, white supremacist, alt-right website The Daily Stormer for violation of terms of service, and in response to the violence in Charlottesville, Virginia.

2017

On 14 August 2017, the New England Holocaust Memorial was damaged for the second time in as many months, by a 17-year-old who threw a rock at one of the glass panels.

2017

Two classroom windows at Temple Israel in Alameda were smashed.

2017

Ruth Thomann, the manager of the Paradies Arosa hotel in Switzerland, stated that it was wrong of her to post signs telling "Jewish guests" to shower before entering the pool and to use the refrigerator at set times, which she had done that year.

2017

Extremists marked the death of Adolf Hitler's deputy, Rudolf Hess, in Berlin. However, protestors blocked them from going to the former Spandau prison, where Hess hanged himself in 1987.

2017

Antisemitic graffiti was written on the walls of Oakland's Temple Sinai on Rosh Hashanah.

2017

ProPublica stated in September that a website was able to target ads at Facebook users who were interested in "how to burn Jew" and "Jew hater". Facebook removed the categories and said it would try to stop them from appearing to potential advertisers.
An 18 October cartoon in the Daily Californian depicting Alan Dershowitz was denounced as anti-Semitic by UC Berkeley Chancellor Carol Christ; Dershowitz agreed that the cartoon was anti-Semitic. In an editorial on 25 October, Daily Californian editor Karim Doumar stated, "The criticisms we received reaffirms for us a need for a more critical editing eye, and a stronger understanding of the violent history and contemporary manifestations of anti-Semitism."

In October 2017, Nigel Farage asserted in a LBC radio broadcast that the "Jewish lobby" in the United States was more concerning to him than Russian interference in American politics, saying: "There are other very powerful lobbies in the United States of America, and the Jewish lobby, with its links with the Israeli government, is one of those strong voices...There are about 6 million Jewish people living in America, so as a percentage it's quite small, but in terms of influence it's quite big." Farage's remarks were condemned by the Campaign Against Antisemitism and the Anti-Defamation League, which said that Farage's comment "plays into deep-seated anti-Semitic tropes" and was fuel for extremist conspiracy theories.

Lecturer Hatem Bazian was denounced by UC Berkeley for retweeting cartoons the school decided had "crossed the line" into anti-Semitism. Bazian apologized and said "the image is offensive and does not represent my views or the anti-racist work that I do." The cartoons were first tweeted by Ron Hughes and later retweeted by Bazian.

When Linda Sarsour was scheduled to deliver a commencement speech at the City University of New York (CUNY) in June 2017, some American conservatives strongly opposed her selection as speaker. Dov Hikind, a Democratic Party state assemblyman in New York, sent Governor Andrew Cuomo a letter objecting to the choice of Sarsour as speaker, signed by 100 Holocaust survivors. Hikind objected to Sarsour's role based on her previously having spoken alongside Rasmea Odeh, who was convicted by an Israeli court for taking part in a bombing that killed two civilians in 1969. Sarsour maintained that she had nothing to apologize for, saying that questions existed about the integrity of Odeh's conviction, that her beliefs had been misrepresented, and that criticism of Israeli policies was being conflated with anti-Semitism. She ascribed the critical reaction to her speech to her prominent role as an organizer for the 2017 Women's March. The university chancellor, the dean of the college, and a group of professors defended her right to speak, as did some Jewish groups, including Jews for Racial and Economic Justice. A group of prominent left-leaning Jews signed an open letter condemning attacks on Sarsour and promising "to [work] alongside her for a more just and equal society". Jonathan Greenblatt of the Anti-Defamation League defended Sarsour's First Amendment right to speak despite opposing her views on Israel. A rally in support
of Sarsour took place in front of New York's City Hall. Constitutional scholar Fred Smith Jr. tied the controversy to broader disputes over freedom of speech in America.

2017

Academy of the Holy Cross in Maryland fired Greg Conte because of his involvement with a white nationalist think tank, Richard Spencer's National Policy Institute. Conte had also written on Twitter that "Hitler did not commit any crimes."

2017

9 December: 2017 Gothenburg Synagogue attack takes place in Gothenburg, Sweden.

2018

It was announced that Germany agreed to grant monetary compensation to Jews who were persecuted in Algeria during World War II; this marks the first time for Jews who resided in Algeria between July 1940 and November 1942 to be compensated by the German government.

2018

On 16 March 2018, Trayon White posted a video on his official Facebook page showing snow flurries falling, alluding to the Rothschild family conspiring to manipulate the weather. In his post, he stated, "Y'all better pay attention to this climate control, man, this climate manipulation ... And that's a model based off the Rothschilds controlling the climate to create natural disasters they can pay for to own the cities, man. Be careful." The comment was widely reported in the Washington media as an endorsement of an anti-Semitic conspiracy theory. The Washington City Paper reported on 19 March that this was not the first time White alluded to a Jewish conspiracy to control global weather. White later apologized for making the statement, and said he was working with Jews United for Justice to develop a deeper understanding of anti-Semitism.

2018

Austrian foreign minister Karin Kneissl recalled diplomat Jürgen-Michael Kleppich from Israel after he was photographed wearing a T-shirt with slogans linked to Nazism.

2018 April 17: 2018 Berlin anti-Semitic attack takes place.

2018

In April 2018, Syracuse University permanently expelled Theta Tau after video of members surfaced that the university chancellor considered to be "extremely racist, anti-Semitic, homophobic, sexist and hostile to people with disabilities."
Alice Walker was asked by a *New York Times* interviewer, "What books are on your nightstand?" She listed David Icke\'s *And the Truth Shall Set You Free*, a book promoting an antisemitic conspiracy theory based on *The Protocols of the Elders of Zion*. Walker described the book as, "A curious person\'s dream come true."

2018

Israeli lawmakers Yuval Steinitz and Oren Hazan accused Jerusalem-born actress Natalie Portman of antisemitism and sought to revoke her citizenship, with Hazan calling her a "little hypocrite liar", after she decided not to travel to Israel and accept the US$2 million Genesis Prize.

2018

In 2018, media outlets reported on calls for the four co-chairs of the Women\'s March to resign for failing to denounce Nation of Islam leader Louis Farrakhan. The *Daily Beast* traced the controversy to February 2018, when Tamika Mallory attended a Nation of Islam Saviours\' Day event hosted by Farrakhan, during which he referred to the "Satanic Jew" and declared that "the powerful Jews are my enemy". The *Daily Beast* later reported that the Women\'s March appeared to be losing support. In October 2018, actress Alyssa Milano, who spoke at the 2018 Women\'s March, told The Advocate that she refused to participate in the 2019 March unless Mallory and Linda Sarsour condemned what have been described as homophobic, antisemitic, and transphobic comments by Farrakhan. The Women\'s March released a statement about anti-Semitism, defending Sarsour and Mallory. In November 2018, Teresa Shook, the co-founder of the Women\'s March, called for march organizers Bob Bland, Mallory, Sarsour and Carmen Perez to resign, saying, "they have allowed anti-Semitism, anti-LGBTQIA sentiment and hateful, racist rhetoric to become a part of the platform by their refusal to separate themselves from groups that espouse these racist, hateful beliefs". The organization\'s leadership rebuffed calls to step down; Sarsour\'s initial response alleged that criticisms were motivated by racism and her opposition to Israel. Sarsour later issued a statement that apologized to the march\'s supporters for its "slow response" and condemned anti-Semitism. In December 2018, Tablet published an article by Leah McSweeney and Jacob Siegel alleging that during the first meeting between Bland, Mallory, Perez, and others in the days after the 2016 US Presidential election, Mallory and Perez repeated an anti-Semitic canard promoted in Farrakhan\'s book *The Secret Relationship Between Blacks and Jews* telling fellow organizer Vanessa Wruble, who is Jewish, that Jews were leaders in the American slave trade and are especially responsible for subsequent exploitation of racial minorities. Wroble suggested that Mallory and Perez had berated her for her Jewish heritage, saying "your people hold all the wealth." Mallory denied Wruble\'s account but acknowledged telling "white women" at the meeting, including Wruble, that she "did not trust them."

2018

The *Echo Music Prize* was heavily criticized worldwide when Farid Bang and Kollegah received the award for best hip hop/urban album in April 2018. The nominated album, *Jung, Brutal, Gutaussehend 3* (English:
"Young, brutal, handsome 3"), contains the track "0815", in which the artists refer to their muscles as being more defined than those of Auschwitz inmates. The duo was even allowed to perform this track during the ceremony, despite heavy protests weeks before the award show. This was much criticized, and as a consequence, the Echo Music Prize was discontinued.

2018

An Israeli man wearing a yarmulke was attacked in Berlin; the attacker allegedly beat him with a belt and shouted, "Yehudi" — the Arabic word for Jew. Authorities stated that the man who was assaulted and another man wearing a yarmulke were insulted by three men and then whipped by one. In response to this, thousands of Germans took part in rallies against antisemitism, many of them wearing yarmulkes.

2018

On 25 February 2018, Tamika Mallory attended an anti-Semitic Louis Farrakhan speech, where she was directly acknowledged by Farrakhan. Farrakhan made multiple inflammatory comments during his three-hour speech. He claimed that "the powerful Jews are my enemy", that "the Jews have control over agencies of those agencies of government" like the FBI, that Jews are "the mother and father of apartheid", and that Jews are responsible for "degenerate behavior in Hollywood turning men into women and women into men". Mallory was criticized for her support of Louis Farrakhan, as well as her support of Assata Shakur, a former Black Liberation Army member convicted of murder.

2018

On 17 April 2018, Tamika Mallory criticized Starbucks for allowing the ADL, an organization dedicated to fighting anti-Semitism, to participate in a company-wide racial bias training after the arrest of two black men at a Starbucks in Philadelphia, claiming that the "ADL attacks black and brown people".

2018

Patrick Little, a Republican candidate for the Senate in California, was openly anti-semitic and even called for a United States "free from Jews."

2018

Paul Nehlen, a Republican candidate for Wisconsin's first congressional district, often made anti-semitic remarks on social media.

2018

John Fitzgerald, an anti-semite and Holocaust denier, was a Republican candidate for the House of Representatives.

2018

Walter Stolper of Florida was arrested after attempting to burn down his condo to "kill all the f------ Jews". 
Arthur J. Jones, an American neo-Nazi far-right white nationalist and Holocaust denier, was the Republican candidate for Illinois's 3rd congressional district.

Antisemitic graffiti was discovered at Congregation Shaarey Tefilla in Indiana.

U.S. Magistrate Mark Hornsby of Louisiana ruled that Jews are racially protected under Title VII of the Civil Rights Act of 1964, in a case regarding Joshua Bonadona's claim Louisiana College’s president, Rick Brewer, refused to approve his hiring because of what he allegedly called Joshua's "Jewish blood."

Stanford University student Hamzeh Daoud, who posted Facebook messages promising to "fight Zionists on campus", resigned as a resident assistant and said he would begin therapy.

Antisemitic graffiti was found on the house where Elie Wiesel was born.

Detention Officers Howard Costner and Jesse Jones of Spalding County were fired because of their online comments expressing sympathy for Hitler and American neo-Nazis.

Antisemite Steve West won the Republican Missouri House primary election in the 15th District.

Germany lifted a blanket ban on Nazi symbolism in video games, including the swastika.

Antisemitic fliers were discovered near and at five East Bay synagogues.

The painting Deux Femmes Dans Un Jardin by Pierre Auguste Renoir, which was stolen from the Jewish art collector Alfred Weinberger by Nazis in 1941, was returned to his granddaughter.

Fliers blaming Jewish people for the sexual assault allegations against Brett Kavanaugh were posted on the University of California campuses of Berkeley and Davis, and at Vassar College.
On 27 October 2018, 11 people were murdered in an attack on the Tree of Life – Or L'Simcha synagogue in Pittsburgh, Pennsylvania.

2018

Justin Trudeau, then the Prime Minister of Canada, gave a formal apology on behalf of Canada for its refusal to accept 907 Jewish refugees who, fleeing Nazi Germany, arrived in Canada on the MS St. Louis in 1939.

2018

A Jewish professor, Elizabeth Midlarsky, found swastikas spray-painted on her office walls at Columbia's Teachers College.

2018

In a Jewish cemetery in Strasbourg, France, antisemitic graffiti was written on tombstones.

2018, 23 March

Murder of Mireille Knoll.

2018 October

Vandals overturn headstones and smash vases in a Jewish cemetery in San Antonio, Texas.

2018 December

Two signs titled "Fake News" and "#MAGA," both frequently expressed by President Donald Trump and his supporters, are planted with arrows beneath them pointing to the marquee for the Holocaust Memorial Museum of San Antonio, Texas.

2019

Belgium outlawed Shechita.

2019

Democratic Rep. Ilhan Omar drew condemnation from Nancy Pelosi, the Democratic House leadership, and a number of Jewish organizations for a tweet that was perceived as antisemitic, in which she alleged that American support for Israel was rooted in money spent by pro-Israel lobbying organizations, notably the American Israel Public Affairs Committee. She later apologized for the tweet in a statement.

2019

Joan Ryan became the eighth MP to quit the Labour Party and join The Independent Group, citing a "culture of anti-Jewish racism" within the party as the reason for her departure.

2019
In February, Polish nationalist based in France disrupted The New Polish School of Holocaust Scholarship conference in EHESS, Paris. The Polish Institute of National Remembrance (IPN) which had made social media postings during the conference and sent a delegate, was criticized by French education minister Frédérique Vidal, who said the disturbances were "highly regrettable" and "anti-Semitic". Vidal further stated the disturbances organized by Gazeta Polska activists, appeared to have been condoned by the IPN whose representative did not condemn the disruption and which criticized the conference on social media that were further re-tweeted by the Embassy of Poland, Paris. Agitators stalked conference speakers in Paris, shouting insults such as "dirty Jew" that hark back to interwar antisemitism.

2019

Ian Austin quit Labour over a "culture of extremism, anti-semitism and intolerance" within the party under Jeremy Corbyn.

2019

Chris Williamson, a Labour MP, was suspended by his party over comments that Labour had "given too much ground" when responding to criticism over its handling of antisemitism within its ranks.

2019

A subway poster in Brooklyn with a picture of Ruth Bader Ginsburg (who is Jewish) was vandalized with the writing "Die, Jew Bitch!" and a swastika.

2019

The uptick in violence against Jews in Brooklyn continues with multiple violent attacks.

2019

The owners of the BerMax Caffé in Winnipeg are alleged to have perpetrated an act of fake antisemitism by vandalizing their cafe and fabricating a claim of assault, in similar fashion to the recent Jussie Smollett case in Chicago.

2019, 4 April

Bet Israel Synagogue of İzmit, Turkey is attacked with a Molotov cocktail.

2019

The synagogue Chabad, of the city of Poway in California, was the site of an attack on 27 April 2019, in which multiple people were shot during Passover services.

2019

A synagogue in Halle, Germany, was attacked by a lone shooter who failed to gain access to the building. Two doors were damaged and improvised explosives set off. The attacker killed two people nearby.
A Church of England report was published called "God’s Unfailing World: Theological and practical perspectives on Christian-Jewish relations", that encouraged Christians to be repentant for "sins of the past" against Jews, and to challenge current stereotypes and attitudes against them. The report was the first time the Church of England made an authoritative statement about antisemitism.

On 10 December 2019, a shooting occurred at a kosher grocery store located in the Greenville section of Jersey City, New Jersey United States. Five people were killed at the store, including the two attackers and three civilians. A civilian and two police officers were wounded. A Jersey City Police Department detective was shot and killed at a nearby cemetery just before the grocery store attack.

Jersey City Mayor Steve Fullop said a trustee of the Jersey City Board of Education, Joan Terrell-Paige, should resign in the wake of her comment after the 2019 Jersey City shooting about Jew "brutes" that according to her have "threatened, intimidated and harassed" black residents. Terrell-Paige further asked whether the public is "brave enough" to listen to the perpetrators' message, and said the local rabbis were selling body parts.

The Executive Order on Combating Anti-Semitism is an executive order announced by U.S. President Donald Trump on Tuesday, 10 December 2019, and signed the next day. The White House initially indicated that the order would define Judaism as a nationality instead of a religion in the United States, though the order ultimately released was more modest in its reach. The purpose of the order is claimed to be to prevent antisemitism by making it easier to use laws prohibiting institutional discrimination against people based on national origin to punish discrimination against Jewish people, including opposition to policies undertaken by the government of Israel. Some American Jews applauded the order, while others objected to defining Judaism as a nationality (as the order was initially indicated to do, though it ultimately did not), claiming that "Trump's reclassification of Judaism mirrored sentiments used by white nationalists and Nazi Germany" and that "the move appears to question whether Jews are really American". Some decried the order as a political stunt, and called on Trump to more directly address the threat of white nationalism.

Monsey Hanukkah stabbing. Five people were injured in a mass stabbing at the home of a Hasidic rabbi, which was hosting Hanukkah celebrations, in Monsey, New York. The suspect was later apprehended by the police.
## Timeline of the Holocaust

<table>
<thead>
<tr>
<th>Date</th>
<th>Major Events</th>
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<tbody>
<tr>
<td>1879</td>
<td>Wilhelm Marr becomes the first proponent of racial anti-Semitism, blaming Jews for the failure of the German revolutions of 1848–49.</td>
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<td>1899</td>
<td>The British-German racist Houston Stewart Chamberlain publishes <em>The Foundations of the Nineteenth Century</em>, in which he writes that the 19th century is &quot;the Jewish age&quot; and he also writes that Europe's social problems are the result of its domination by the Jews. The book eventually influences the Nazi Party.</td>
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<td>1903</td>
<td><em>The Protocols of the Elders of Zion</em>, a document forged by the Okhrana purporting to reveal the secret plans of a conspiracy of Jewish religious leaders for world conquest through the imposition of liberal democracy, is published in Znamya in the Russian Empire. It is later distributed across the world after 1917 by white Russian émigrés and becomes a popular anti-Semitic tract even after it was proved to have been forged and plagiarized.</td>
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<td>24 October 1917</td>
<td>The Bolsheviks led by Vladimir Lenin take power in Russia with the October Revolution. The subsequent Revolutions of 1917-1923 cause fears of Communist expansion into Europe that would influence the European far right.</td>
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<tr>
<td>11 November 1918</td>
<td>World War I ends with the Compiègne Armistice after the German Empire collapses due to the Revolution.</td>
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<td>1919</td>
<td>France deploys African colonial troops in the Allied occupation of the Rhineland, resulting in mixed-race children between the troops and German women. The children, disparagingly called &quot;Rhineland Bastards&quot; are subject to racial discrimination and prejudice.</td>
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<td>5 January 1919</td>
<td>The German Workers' Party is founded by Anton Drexler and Karl Harrer as an offshoot of the Thule Society, one of the many far-right, anti-Semitic, anti-communist and völkisch groups which were formed in Germany after the war.</td>
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<td>7 May 1919</td>
<td>The Treaty of Versailles is presented to the German delegation to the Paris Peace Conference. Most Germans disapprove of the reparations payments and the forced acceptance of German war guilt entailed in Article 231.</td>
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<tr>
<td>16 September 1919</td>
<td>Adolf Hitler, having joined the German Workers' Party, makes his first endorsement of racial anti-Semitism.</td>
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<td>18 November 1919</td>
<td><em>Generalfeldmarschall</em> Paul von Hindenburg gives testimony to the Weimar National Assembly blaming the loss of World War I on &quot;the secret intentional mutilation of the fleet and the army&quot; and made misleading claims that a British general admitted that the German Army was &quot;stabbed in the back,&quot; giving rise to the popular stab-in-the-back conspiracy theory. He is later elected President of Germany in the 1925 presidential election.</td>
</tr>
</tbody>
</table>
| 24 February     | In a speech before approximately 2,000 people in the Munich Festival of the Hofbräuhaus, Hitler
1920 | proclaimed the 25-Point Program of the German Workers' Party, later renamed the National Socialist (Nazi) German Workers' Party. Among other things, the program called for the establishment of a Pan-German state, with citizenship, residency, and other civil rights only reserved for ethnic Germans, explicitly excluding Jews and all non-Germans.

1921 | The Nazi Party forms the Sturmabteilung (SA) under the Division for Propaganda and Sports.

20 April 1923 | The first issue of Der Stürmer, a highly anti-Semitic tabloid-format newspaper published by Julius Streicher, is released.

8 November 1923 | Inspired by the March on Rome, Hitler organizes the Beer Hall Putsch, an attempted coup d'état. Although Hitler is sentenced to 5 years in Landsberg Prison and the Nazi Party is briefly proscribed, Hitler gains public notice for the first time.

18 July 1925 | Adolf Hitler publishes Mein Kampf.

24 October 1929 | The Wall Street Crash of 1929 occurs, beginning the Great Depression and allowing Hitler to gain support.

1931 | To prevent the transfer of currency out of the country, President von Hindenburg decrees a 25 percent emigration tax, the Reich Flight Tax. The Tax later becomes a hindrance to Jews trying to emigrate out of Germany.

July 1932 | Nazis became the largest party in the Reichstag, capturing 230 of the 608 seats in the German federal election of July, 1932.

30 January 1933 | Adolf Hitler appointed Chancellor of Germany

February 1933 | Chancellor Hitler sets his military policy as "the conquest of new Lebensraum in the East and its ruthless Germanization" in a secret meeting with the Reichswehr.

27 February 1933 | The Reichstag fire. The subsequent Reichstag Fire Decree suspends the German Constitution and most civil liberties.

9 March 1933 | Dachau concentration camp, the first concentration camp in Germany, opens 10 miles northwest of Munich at an abandoned munitions factory.

13 March 1933 | The Reich Ministry of Public Enlightenment and Propaganda is established under Joseph Goebbels.

21 March 1933 | Oranienburg concentration camp is opened at a former brewery in Oranienburg by an SA brigade near Berlin.

23 March 1933 | The Enabling Act of 1933 enacted, allowing Hitler to rule by decree.

31 March 1933 | Hanns Kerrl and Hans Frank issue legislation in the states of Prussia and Bavaria dismissing Jewish judges and prosecutors and imposing quotas for lawyers and notaries.

1 April 1933 | Nazi boycott of Jewish businesses begins.

7 April 1933 | The Law for the Restoration of the Professional Civil Service, banning most Jews and Communists from government employment, is passed. Shortly after, a similar law affects lawyers, doctors, tax consultants, musicians, and notaries.

22 April 1933 | The Decree Licensing Physicians from the National Health Service passed on the pressure of
<table>
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<tr>
<th>Date</th>
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<tbody>
<tr>
<td>25 April 1933</td>
<td>Dr. Gerhard Wagner excludes Jewish doctors from medical service.</td>
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<td>29 April 1933</td>
<td>The Law for Preventing Overcrowding in German Schools and Schools of Higher Education severely limits Jewish enrollment in German public schools.</td>
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<td>2 May 1933</td>
<td>Gestapo (German Secret Police) established by Hermann Göring.</td>
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<td>10 May 1933</td>
<td>German trade unions banned and replaced by the German Labor Front under the leadership of Robert Ley.</td>
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<tr>
<td>1 June 1933</td>
<td>Nazi book burnings begin. Books deemed &quot;un-German,&quot; including all works by Jewish authors, are consumed in ceremonial bonfires, including a large one on the Unter den Linden adjacent to the University of Berlin.</td>
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<td>22 June 1933</td>
<td>The Law for the Prevention of Unemployment provides marriage loans to genetically &quot;fit&quot; Germans.</td>
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<tr>
<td>14 July 1933</td>
<td>Inmates from Düsseldorf begin arriving at Emslandlager.</td>
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<td>17 September 1933</td>
<td>The Reichsvertretung der Deutschen Juden is established as the legal representative body of German Jews under the leadership of Leo Baek and Otto Hirsch.</td>
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<td>20 September - 23 December 1933</td>
<td>Leipzig trial acquits 3 of 4 men accused of Reichstag fire. Furious, Hitler establishes a People's Court to try political crimes.</td>
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<td>22 September 1933</td>
<td>The Reich Chamber of Culture is established, effectively barring Jews from the arts.</td>
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<tr>
<td>1 January 1934</td>
<td>Hitler removes all Jewish holidays from the German calendar.</td>
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<tr>
<td>24 January 1934</td>
<td>All Jews are expelled from the German Labor Front.</td>
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<tr>
<td>April 1934</td>
<td>Heinrich Himmler, who had become the leader of the entire German police force outside of Prussia the previous year, is appointed Reichsführer-SS. The Volksgericht is established to prosecute political dissidents.</td>
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<td>Date</td>
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<tr>
<td>1 May 1934</td>
<td>The Office of Racial Policy is established within the Nazi Party.</td>
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<td>17 May 1934</td>
<td>Jews lose access to statutory health insurance. The German American</td>
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<td>Bund holds a rally in Madison Square Garden.</td>
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<td>9 June 1934</td>
<td>The SD is established as the Nazi Party's intelligence agency.</td>
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<td>14 June 1934</td>
<td>Hitler begins a purge of the SA and the non-Nazi conservative</td>
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<td>revolutionary movement through the SS under pressure from the</td>
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<td>Reichswehr. Hitler's colleague Ernst Röhm, the former Chancellor</td>
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<td></td>
<td>Kurt von Schleicher, and Gustav Ritter von Kahr are killed. The move</td>
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<td></td>
<td>guarantees Hitler military support, quashes his opposition, and</td>
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<td></td>
<td>enhances the power of the SS. It also begins an increase in the</td>
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<td></td>
<td>persecution of homosexuals in Nazi Germany.</td>
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<td>4 July 1934</td>
<td>The Concentration Camps Inspectorate (IKL) is established under</td>
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<td>Theodor Eicke.</td>
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<tr>
<td>2-19 August 1934</td>
<td>Hitler becomes President of Germany upon the death of Paul von</td>
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<td></td>
<td>Hindenburg, and becomes an absolute dictator by merging the office</td>
</tr>
<tr>
<td></td>
<td>with the Chancellor to become the Führer. All Reichswehr members</td>
</tr>
<tr>
<td></td>
<td>swear the Hitler oath.</td>
</tr>
<tr>
<td>7 October 1934</td>
<td>Jehovah's Witnesses in Germany issue letters protesting the</td>
</tr>
<tr>
<td></td>
<td>persecution of their religion and affirming their political</td>
</tr>
<tr>
<td></td>
<td>neutrality.</td>
</tr>
<tr>
<td>December 1934</td>
<td>Himmler gains control of the Gestapo through his subordinate</td>
</tr>
<tr>
<td></td>
<td>Reinhard Heydrich.</td>
</tr>
<tr>
<td>1 April 1935</td>
<td>Anti-Semitic legislation is expanded to the Saarland after the</td>
</tr>
<tr>
<td></td>
<td>1935 Saar status referendum.</td>
</tr>
<tr>
<td>May 1935</td>
<td>Jews are excluded from the Wehrmacht, military members are banned</td>
</tr>
<tr>
<td></td>
<td>from marrying &quot;non-Aryans&quot;.</td>
</tr>
<tr>
<td>26 June 1935</td>
<td>The Law for the Prevention of Hereditarily Diseased Offspring is</td>
</tr>
<tr>
<td></td>
<td>amended to institute compulsory abortion.</td>
</tr>
<tr>
<td>28 June 1935</td>
<td>Paragraph 175 is expanded to prohibit all homosexual acts.</td>
</tr>
<tr>
<td>15 September 1935</td>
<td>Nuremberg Laws are unanimously passed by the Reichstag. Jews are</td>
</tr>
<tr>
<td></td>
<td>no longer citizens of Germany and cannot marry Germans.</td>
</tr>
<tr>
<td>December 1935</td>
<td>The SS Race and Settlement Main Office establishes the <em>Lebensborn</em></td>
</tr>
<tr>
<td></td>
<td>program.</td>
</tr>
<tr>
<td>10 February 1936</td>
<td>The Gestapo is given extrajudicial authority.</td>
</tr>
<tr>
<td>3 March 1936</td>
<td>German Jewish doctors are banned from practicing on German patients.</td>
</tr>
<tr>
<td>29 March 1936</td>
<td>The <em>SS-Totenkopfverbände</em> is established.</td>
</tr>
<tr>
<td>6 June 1936</td>
<td>Minister of the Interior Wilhelm Frick authorizes the deportation</td>
</tr>
<tr>
<td></td>
<td>of the Romani people to concentration camps such as Marzahn.</td>
</tr>
<tr>
<td>June 1936</td>
<td>Himmler becomes Chief of German Police, and establishes the Orpo,</td>
</tr>
<tr>
<td></td>
<td>the Sipo, and the Kripo under SS control.</td>
</tr>
<tr>
<td>12 July 1936</td>
<td>Concentration camp inmates are transferred to Oranienburg to begin</td>
</tr>
<tr>
<td></td>
<td>construction on Sachsenhausen concentration camp.</td>
</tr>
<tr>
<td>1 August 1936</td>
<td>The 1936 Summer Olympics open in Berlin, leading to a temporary</td>
</tr>
<tr>
<td></td>
<td>abatement in open anti-Semitism.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>-----------------------</td>
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</tr>
<tr>
<td>28 August 1936</td>
<td>Mass arrests of Jehovah’s Witnesses begin.</td>
</tr>
<tr>
<td>7 October 1936</td>
<td>A 25 percent tax is imposed on Jewish assets.</td>
</tr>
<tr>
<td>1937</td>
<td>Beginning of the Nazis' policy of seizure of Jewish property through &quot;Aryanization&quot;.</td>
</tr>
<tr>
<td>27 February 1937</td>
<td>The Kripo begins the first mass roundup of political opponents.</td>
</tr>
<tr>
<td>14 March 1937</td>
<td>Pope Pius XI publishes an encyclical, <em>Mit brennender Sorge</em>, condemning the Nazis and accusing them of violating the Reichkonkordat.</td>
</tr>
<tr>
<td>15 July 1937</td>
<td>Buchenwald concentration camp opens in Ettersburg five miles from Weimar.</td>
</tr>
<tr>
<td>8 November 1937</td>
<td>Der ewige Jude (The Eternal Jew) exhibition opens in Munich.</td>
</tr>
<tr>
<td>14 December 1937</td>
<td>Himmler issues a decree that the German Criminal Police (Kripo) does not have to have evidence of a specific criminal act in order to detain persons suspected of asocial or criminal behavior indefinitely.</td>
</tr>
<tr>
<td>12 March 1938</td>
<td>Austria annexed by Nazi Germany (the Anschluss). All German anti-Jewish laws now apply in Austria.</td>
</tr>
<tr>
<td>24 March 1938</td>
<td>Flossenbürg concentration camp is opened in Flossenbürg, Bavaria, ten miles from the border with Czechoslovakia.</td>
</tr>
<tr>
<td>26 April 1938</td>
<td>Jews are required to register all property over RM 5,000 under the Four Year Plan.</td>
</tr>
<tr>
<td>29 May 1938</td>
<td>Hungary, under Miklós Horthy, passes the first of a series of anti-Jewish measures emulating Germany’s Nuremberg Laws.</td>
</tr>
<tr>
<td>13-18 June 1938</td>
<td>The first mass arrests of Jews begin through <em>Aktion Arbeitsscheu Reich</em>.</td>
</tr>
<tr>
<td>6-15 July 1938</td>
<td>U.S. President Franklin D. Roosevelt convenes the Évian Conference in Évian-les-Bains, France, to settle the issue of Jewish refugees, but only Costa Rica and the Dominican Republic allow more refugees.</td>
</tr>
<tr>
<td>8 July 1938</td>
<td>Manifesto of Race published in Fascist Italy, led to stripping the Jews of Italian citizenship and governmental and professional positions</td>
</tr>
<tr>
<td>8 August 1938</td>
<td>The SS opens the Mauthausen-Gusen concentration camp complex near Linz, and establishes DEST to operate a stone quarry.</td>
</tr>
<tr>
<td>27 September 1938</td>
<td>The German government completely prohibits Jews from practicing law.</td>
</tr>
<tr>
<td>30 September 1938</td>
<td>The German government completely prohibits Jews from practicing medicine.</td>
</tr>
<tr>
<td>31 September 1938</td>
<td>The United Kingdom and France agree to allow Hitler to seize control of the Sudetenland under the Munich Agreement.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>----------------------</td>
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</tr>
<tr>
<td>5 October 1938</td>
<td>Jews are required to have a red J in their passports.</td>
</tr>
<tr>
<td>9–10 November 1938</td>
<td>Kristallnacht</td>
</tr>
<tr>
<td>12 November 1938</td>
<td>Jews are banned from buying and selling goods under Decree on the Elimination of the Jews from Economic Life, and are fined $400 million to repair damage from Kristallnacht.</td>
</tr>
<tr>
<td>15 November 1938</td>
<td>All Jewish children are expelled from German public schools.</td>
</tr>
<tr>
<td>December 1938-August 1939</td>
<td>German Jewish child refugees are allowed to emigrate to the United Kingdom and France through the Kindertransport program.</td>
</tr>
<tr>
<td>1 January 1939</td>
<td>All Jewish-owned businesses are closed under the Law Excluding Jews from Commercial Enterprises.</td>
</tr>
<tr>
<td>24 January 1939</td>
<td>Hitler directs Heydrich to establish the Central Office for Jewish Emigration.</td>
</tr>
<tr>
<td>14-16 March 1939</td>
<td>Czechoslovakia is dissolved as Slovakia declares independence as a satellite state, and the Nazis occupy the remainder as the Protectorate of Bohemia and Moravia.</td>
</tr>
<tr>
<td>21 March 1939</td>
<td>The Klaipėda Region is annexed by Germany.</td>
</tr>
<tr>
<td>13 May 1939</td>
<td>MS St. Louis sails from Hamburg to Cuba with 937 refugees, mostly Jews. Only 29 are allowed in. The rest, refused by Cuba, the United States and Canada are returned to Europe.</td>
</tr>
<tr>
<td>17 May 1939</td>
<td>Jewish immigration to Mandatory Palestine is curtailed by the British government through the MacDonald White Paper.</td>
</tr>
<tr>
<td>June 1939</td>
<td>The Wagner–Rogers Bill, which would have increased immigration quotas for German Jewish children, dies in committee despite endorsement from the Roosevelt administration.</td>
</tr>
<tr>
<td>18 August 1939</td>
<td>The Interior Ministry requires midwives and pediatricians to report infants with hereditary disorders.</td>
</tr>
<tr>
<td>18 October 1939</td>
<td>First shipment of Jews to Lublin Reservation</td>
</tr>
<tr>
<td>1 September 1939</td>
<td>The German invasion of Poland starts World War II in Europe. Thousands of Polish Jews are killed by the SS-Einsatzgruppen during Operation Tannenberg.</td>
</tr>
<tr>
<td>2 September 1939</td>
<td>Stutthof concentration camp is established near Danzig.</td>
</tr>
<tr>
<td>21 September 1939</td>
<td>Heydrich orders all German Jews to be shipped to Poland and for all Polish Jews to be concentrated in major cities.</td>
</tr>
<tr>
<td>October 1939</td>
<td>Thousands of Jews are shipped from Vienna, Ostrava, and Katowice to the Lublin Reservation in Zarzecze, Nisko County.</td>
</tr>
<tr>
<td>October 1939</td>
<td>The Netherlands establishes a refugee camp for Central European Jewish refugees at Westerbork, Drenthe. After the German invasion the camp is converted into a transit camp to transport Jews to death camps.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>8 October 1939</td>
<td>The first Nazi ghetto is completed in Piotrków Trybunalski.</td>
</tr>
<tr>
<td>26 October 1939</td>
<td>All territory not directly annexed by Nazi Germany or the Soviet Union is placed under the Generalgouvernement.</td>
</tr>
<tr>
<td>28 October 1938</td>
<td>The Generalgouvernement imposes compulsory labor requirements on Jews.</td>
</tr>
<tr>
<td>1940</td>
<td>Bergen-Belsen is opened near Celle as a prisoner-of-war camp.</td>
</tr>
<tr>
<td>30 January 1940</td>
<td>The German government decides to expel Gypsies to Poland.</td>
</tr>
<tr>
<td>April 1940</td>
<td>Rudolf Höss visits Oświęcim to inspect its suitability as a concentration camp for Polish political prisoners and as a colony for German settlers in Lower Silesia. Himmler approves construction of Auschwitz concentration camp.</td>
</tr>
<tr>
<td>9 April 1940</td>
<td>The German invasion of Denmark and the Norwegian Campaign begin.</td>
</tr>
<tr>
<td>30 April 1940</td>
<td>The Łódź Ghetto, the first Nazi ghetto, is sealed.</td>
</tr>
<tr>
<td>10 May 1940</td>
<td>The Battle of France begins, and Netherlands, Belgium, and Luxembourg quickly fall under German control.</td>
</tr>
<tr>
<td>15 May 1940</td>
<td>The Netherlands capitulates to the Germans, and Arthur Seyss-Inquart is appointed to lead the Reichskommissariat Niederlande.</td>
</tr>
<tr>
<td>28 May 1940</td>
<td>Belgium capitulates to the Germans</td>
</tr>
<tr>
<td>May 1940</td>
<td>Auschwitz I opens</td>
</tr>
<tr>
<td>June 1940</td>
<td>The National Assembly votes to surrender with the Armistice of 22 June 1940. Vichy France is established as a collaborationist state under Philippe Pétain and Pierre Laval.</td>
</tr>
<tr>
<td>4 June 1940</td>
<td>The IKL designates Neuengamme concentration camp in the outskirts of Hamburg as an independent concentration camp.</td>
</tr>
<tr>
<td>14 June 1940</td>
<td>The first prisoners arrive at Auschwitz.</td>
</tr>
<tr>
<td>19 June 1940</td>
<td>All telephones are confiscated from Jews.</td>
</tr>
<tr>
<td>June 1940</td>
<td>The Soviet Union annexes the Baltic States, Northern Bukovina, and Bessarabia with German support.</td>
</tr>
<tr>
<td>July 1940</td>
<td>Germany directly annexes Alsace and Lorraine, and 3,000 Alsatian Jews are deported to the zone libre of southern France.</td>
</tr>
<tr>
<td>17 July 1940</td>
<td>Non-French aliens are banned from taking public posts in Vichy France, a measure targeting Jews.</td>
</tr>
<tr>
<td>15 August 1940</td>
<td>Adolf Eichmann proposes the Madagascar Plan.</td>
</tr>
<tr>
<td>September 1940</td>
<td>The Vichy government converts refugee camps established for Spanish Republican and German Jewish refugees, such as Gurs and Rivesaltes, into transit camps.</td>
</tr>
<tr>
<td>September 1940</td>
<td>Anti-Semitic legislation is formulated in Slovakia under pressure from the German government.</td>
</tr>
<tr>
<td>September 1940</td>
<td>All public officials in the Reichskommissariat Niederlande are forced to attest to their Aryan background, and all Jews are eventually ordered to resign by December 31.</td>
</tr>
<tr>
<td>6 September</td>
<td>King Carol II abdicates after the Second Vienna Award forces Romania to surrender Transylvania to</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>1940</td>
<td>Hungary. The National Legionary State, a coalition between the Romanian Army under Ion Antonescu and the fascist Iron Guard under Horia Simia, comes to power.</td>
</tr>
<tr>
<td>20 September 1940</td>
<td>Breendonk internment camp, a former National Redoubt fortress in Antwerp, is opened for prisoners in Nazi-occupied Belgium.</td>
</tr>
<tr>
<td>24 September 1940</td>
<td>Veit Harlan's anti-Semitic propaganda film Jud Süß premieres in Germany.</td>
</tr>
<tr>
<td>27 September – 24 November 1940</td>
<td>Germany, Italy, and Japan conclude the Tripartite Pact establishing the Axis Powers. Slovakia, Hungary, and Romania accede to the Pact as well.</td>
</tr>
<tr>
<td>3 October 1940</td>
<td>Vichy France issues the Statut des Juifs discriminating against Jews. The law leads to similar anti-Semitic actions in French North Africa.</td>
</tr>
<tr>
<td>12 October 1940</td>
<td>All Jews are deported from Luxembourg on the orders of Gustav Simon. The Warsaw Ghetto, the largest ghetto in the General Government, is established.</td>
</tr>
<tr>
<td>28 October 1940</td>
<td>General Alexander von Falkenhausen issues an order prohibiting Jews from working as civil servants, teachers, lawyers, broadcasters, or newspaper editors in the Reichskommissariat of Belgium and Northern France.</td>
</tr>
<tr>
<td>15 November 1940</td>
<td>The Warsaw Ghetto is sealed.</td>
</tr>
<tr>
<td>28 November 1940</td>
<td>Fritz Hippler's anti-Semitic pseudo-documentary The Eternal Jew premieres.</td>
</tr>
<tr>
<td>18 December 1940</td>
<td>Hitler approves Operation Barbarossa, the plan for the German invasion of the Soviet Union</td>
</tr>
<tr>
<td>21-23 January 1941</td>
<td>The Iron Guard attempts a coup d'etat against Antonescu in the Legionnaires' rebellion. The Army suppresses the coup with aid from the Wehrmacht and the German Foreign Office, and executes a pogrom in Bucharest.</td>
</tr>
<tr>
<td>24-25 February 1941</td>
<td>The February strike is organized by the Dutch Communist Party to protest deportations of Jews. Although suppressed, the strike leads to a temporary abatement of anti-Semitic policy.</td>
</tr>
<tr>
<td>March 1941</td>
<td>The Kraków Ghetto is established.</td>
</tr>
<tr>
<td>1 March 1941</td>
<td>Himmler orders the expansion of Auschwitz.</td>
</tr>
<tr>
<td>6 April 1941</td>
<td>Nazi Germany invades Yugoslavia and Greece.</td>
</tr>
<tr>
<td>10 April 1941</td>
<td>The Independent State of Croatia is established.</td>
</tr>
<tr>
<td>21 May 1941</td>
<td>The Natzweiler-Struthof concentration camp is established near Strasbourg.</td>
</tr>
<tr>
<td>22 June 1941</td>
<td>Operation Barbarossa commences and the Wehrmacht enters Soviet territory</td>
</tr>
<tr>
<td>23 June 1941</td>
<td>The Einsatzgruppen begin extermination operations.</td>
</tr>
<tr>
<td>28 June 1941</td>
<td>Minsk is captured after the Wehrmacht offensive in Belarus.</td>
</tr>
<tr>
<td>1 July 1941</td>
<td>Riga and Lviv are captured by the Wehrmacht.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>-----------------------</td>
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</tr>
<tr>
<td>11 July 1941</td>
<td>The Kovno Ghetto is established.</td>
</tr>
<tr>
<td>20 July 1941</td>
<td>The Minsk Ghetto is established.</td>
</tr>
<tr>
<td>21 July-31 August 1941</td>
<td>Bessarabian Jews are massacred by the Wehrmacht, the Romanian Army, and Einsatzgruppe D.</td>
</tr>
<tr>
<td>August 1941</td>
<td>The Drancy internment camp is established by the Sipo near Paris, and is staffed by French gendarmes.</td>
</tr>
<tr>
<td>1 August 1941</td>
<td>Eastern Galicia and Lvov are annexed to the General Government, and the Bialystok Ghetto is established.</td>
</tr>
<tr>
<td>3 September 1941</td>
<td>First gassings at Auschwitz using Zyklon B</td>
</tr>
<tr>
<td>15 September 1941</td>
<td>Dutch Jews are prohibited from appearing in public and are deprived of the majority of their assets. The deportation of Romanian Jews to Transnistria begins.</td>
</tr>
<tr>
<td>29–30 September 1941</td>
<td>Babi Yar massacre of 33,771 Jews</td>
</tr>
<tr>
<td>10 October 1941</td>
<td>Field Marshal Walter von Reichenau of the German Sixth Army issues a secret memorandum ordering the Wehrmacht to approve violations of international law in the invasion of the Soviet Union.</td>
</tr>
<tr>
<td>11-12 December 1941</td>
<td>Jews are rounded up in Lublin and interned in Majdanek concentration camp</td>
</tr>
<tr>
<td>20 January 1942</td>
<td>Wannsee Conference plans &quot;final solution&quot;</td>
</tr>
<tr>
<td>27 March 1942</td>
<td>first of at least 75,721 French Jews deported from France, to Auschwitz</td>
</tr>
<tr>
<td>6 July 1942</td>
<td>Anne Frank and her family go into hiding</td>
</tr>
<tr>
<td>22 July 1942</td>
<td>first deportation from Warsaw Ghetto to Treblinka during Grossaktion Warsaw</td>
</tr>
<tr>
<td>23 July 1942 – 19 October 1943</td>
<td>Treblinka death camp operates, 700-900 thousand Jews murdered</td>
</tr>
<tr>
<td>4 August 1942</td>
<td>Jewish internees at Breendonk are sent to the Mechelen transit camp in preparation for deportation to Auschwitz.</td>
</tr>
<tr>
<td>23 October 1942</td>
<td>Jewish emigration from Nazi-controlled territory is prohibited.</td>
</tr>
<tr>
<td>19 November 1942</td>
<td>first shipment of Jews from Norway</td>
</tr>
<tr>
<td>19 April 1943 – 16 May 1943</td>
<td>Warsaw Ghetto Uprising</td>
</tr>
<tr>
<td>1943</td>
<td>Bergen-Belsen is converted into a concentration camp.</td>
</tr>
<tr>
<td>2 August 1943</td>
<td>Treblinka revolt</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>--------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>16 August 1943</td>
<td>The Bialystok Ghetto is liquidated.</td>
</tr>
<tr>
<td>2 September 1943</td>
<td>The Tarnów Ghetto is liquidated.</td>
</tr>
<tr>
<td>11-14 September 1943</td>
<td>The Minsk Ghetto is liquidated.</td>
</tr>
<tr>
<td>14 October 1943</td>
<td>Sobibor revolt and escape</td>
</tr>
<tr>
<td>3 November 1943</td>
<td>German forces commence Operation Harvest Festival, resulting in the deaths of 43,000 Jews in the Lublin District.</td>
</tr>
<tr>
<td>9 November 1943</td>
<td>The 43-nation United Nations Relief and Rehabilitation Administration is founded by the Allied Powers at the White House, and is placed under the authority of the Supreme Headquarters Allied Expeditionary Force</td>
</tr>
<tr>
<td>1944</td>
<td>Raphael Lemkin, a former law lecturer at Duke University and U.S. War Department analyst, coins the term genocide in his book <em>Axis Rule in Occupied Europe</em></td>
</tr>
<tr>
<td>19 March 1944</td>
<td>German troops occupy Hungary</td>
</tr>
<tr>
<td>early May 1944</td>
<td>first transport of Hungarian Jews, to Auschwitz, began</td>
</tr>
<tr>
<td>9 July 1944</td>
<td>Miklós Horthy halts deportations of Hungarian Jews to Auschwitz.</td>
</tr>
<tr>
<td>23 June 1944</td>
<td>Red Cross representatives see elaborately staged Nazi propaganda ruse at Theresienstadt designed to portray camps as benign</td>
</tr>
<tr>
<td>20 July 1944</td>
<td>Attempt to assassinate Hitler fails</td>
</tr>
<tr>
<td>23 July 1944</td>
<td>Majdanek, first major death camp liberated, by the advancing Soviet Red Army along with Lublin.</td>
</tr>
<tr>
<td>24 July 1944</td>
<td>Greek Jews in Rhodes are deported to Auschwitz.</td>
</tr>
<tr>
<td>1 August 1944</td>
<td>Warsaw Uprising begins</td>
</tr>
<tr>
<td>4 August 1944</td>
<td>Anne Frank and her family arrested and eventually deported to Auschwitz</td>
</tr>
<tr>
<td>16 August 1944</td>
<td>Nazi authorities flee the Drancy camp, and it is taken by the French Red Cross.</td>
</tr>
<tr>
<td>3 September 1944</td>
<td>The final transport of Dutch Jews from Westerbork leaves for Auschwitz.</td>
</tr>
<tr>
<td>October 1944</td>
<td>Mittelbau-Dora concentration camp, created the previous summer when Buchenwald inmates were sent to Nordhausen to construct underground aircraft factories to produce V-2 rockets, is made an independent concentration camp.</td>
</tr>
<tr>
<td>7 October 1944</td>
<td>Crematorium IV at Auschwitz destroyed in Sonderkommando uprising</td>
</tr>
<tr>
<td>15 October 1944</td>
<td>Miklós Horthy's government in Hungary is overthrown in Operation Panzerfiuust and deportations to Auschwitz resume under the Government of National Unity.</td>
</tr>
<tr>
<td>5 November 1944</td>
<td>Adolf Eichmann authorizes the first death marches to the Budapest Ghetto.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>----------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>1944</td>
<td>genocide</td>
</tr>
<tr>
<td>27 January 1945</td>
<td>Auschwitz death camp liberated by the 60th Army of the First Ukrainian Front. Anniversary is observed as International Holocaust Remembrance Day.</td>
</tr>
<tr>
<td>c. February or March 1945</td>
<td>Anne Frank and her sister Margot die in Bergen-Belsen</td>
</tr>
<tr>
<td>4 April 1945</td>
<td>Ohrdruf subcamp of Buchenwald is liberated by the 4th Armored Division, and is the first German concentration camp to be reached by American military forces</td>
</tr>
<tr>
<td>11 April 1945</td>
<td>Buchenwald death camp liberated by the 6th Armored Division of the U.S. Third Army. Dora-Mittelbau is liberated by the U.S. 104th Infantry Division</td>
</tr>
<tr>
<td>12 April 1945</td>
<td>Westerbork transit camp is liberated by the 2nd Canadian Infantry Division</td>
</tr>
<tr>
<td>15 April 1945</td>
<td>Bergen-Belsen death camp is liberated by the 11th Armoured Division of the British Army</td>
</tr>
<tr>
<td>19 April 1945</td>
<td>9,000 prisoners of Neuengamme are evacuated to Lübeck due to the advancing British Army, while 3,000 prisoners are murdered and 700 German prisoners remain behind to destroy files and are conscripted into the SS.</td>
</tr>
<tr>
<td>29 April 1945</td>
<td>Dachau liberated by the Americans and Ravensbrück by the Soviets</td>
</tr>
<tr>
<td>30 April 1945</td>
<td>Adolf Hitler suicide</td>
</tr>
<tr>
<td>3-4 May 1945</td>
<td>The British liberate Neuengamme. The SS attempts to evacuate the remaining prisoners on ocean liners, resulting in the deaths of thousands of prisoners after a Royal Air Force raid sinks the <em>Cap Ancona</em> and the Thielbek.</td>
</tr>
<tr>
<td>5 May 1945</td>
<td>Mauthausen liberated by the Americans</td>
</tr>
<tr>
<td>8 May 1945</td>
<td>Theresienstadt liberated by the Soviets</td>
</tr>
<tr>
<td>23 May 1945</td>
<td>Heinrich Himmler suicide</td>
</tr>
<tr>
<td>June 1945</td>
<td>The U.S. State Department commissions a report on UNRRA displaced persons camps by Earl G. Harrison, who protests poor conditions in the camps. The Harrison Report is read by U.S. President Harry S Truman and British Prime Minister Clement Attlee and published in <em>The New York Times</em></td>
</tr>
<tr>
<td>20 November 1945–1 October 1946</td>
<td>first Nuremberg trials, of 24 top Nazi officials</td>
</tr>
<tr>
<td>20 December 1945</td>
<td>The Allied Control Council issues Law No. 22 allowing individual courts to try war criminals and Holocaust perpetrators.</td>
</tr>
<tr>
<td>22 December 1945</td>
<td>President Truman issues an executive order mandating that displaced persons from the Holocaust be given preference in the U.S. immigration system.</td>
</tr>
<tr>
<td>2 July 1946</td>
<td>Orson Welles' <em>The Stranger</em>, first feature film with concentration camp footage, released. Hundreds more feature films and documentaries about the Holocaust would be made.</td>
</tr>
</tbody>
</table>
1947 | UNRRA is superseded by the International Refugee Organization
---|---
25 June 1947 | *The Diary of a Young Girl*, Anne Frank's diary, is published in the Netherlands
11 July 1947 | SS Exodus departs France for the British Mandate of Palestine. Her 4,515 passengers, mostly Holocaust survivors, are intercepted by the British Navy and shipped back to camps in Germany.
1948 | The 80th United States Congress passes the Displaced Persons Act allowing 200,000 displaced persons to enter the United States
14 May 1948 | State of Israel declares independence
9 December 1948 | The United Nations ratifies the Convention on the Prevention and Punishment of Genocide
1949 | Separate postwar civilian governments in East and West Germany are formed due to the beginning of the Cold War
1950 | The Displaced Persons Act is amended to remove restrictions to Jewish displaced persons.
1951 | West German Chancellor Konrad Adenauer and Israeli Prime Minister David Ben-Gurion begin negotiations for an agreement on reparations.
1952 | The last displaced persons camps in Europe are closed, with most of its inhabitants having been successfully resettled
10 September 1952 | Israel and West Germany ratify the Reparations Agreement in Luxembourg allowing for reparations payments between the two countries between 1953 and 1965.
25 August 1953 | The Knesset founds Yad Vashem.
11 May 1960 | Adolf Eichmann, one of the major organizers of the Holocaust, is captured in Argentina, and brought to Israel where he is tried, convicted.
31 May 1962 | Adolf Eichmann executed
20 December 1963 - 19 August 1965 | The Frankfurt Auschwitz trials occur, the first trial of German Holocaust perpetrators by the West German civilian judicial system
22 August 1993 | The United States Holocaust Memorial Museum is founded in Washington, D.C.
1998 | Maurice Papon, a former civil servant who facilitated the deportation of Jews from Bordeaux, is convicted for crimes against humanity by a French court, renewing public awareness of the role of French collaborationists in the Holocaust.

**Timeline of the Holocaust in Norway**
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>17 May 1933</td>
<td>Vidkun Quisling founds Nasjonal Samling</td>
</tr>
<tr>
<td>7 February 1939</td>
<td>Quisling gives speech on the &quot;Jewish Danger&quot;</td>
</tr>
<tr>
<td>9 April 1940</td>
<td>Operation Weserübung: German forces invade and occupy Norway</td>
</tr>
<tr>
<td>10 April 1940</td>
<td>The Gestapo arrives in Haugesund, seeking to arrest Moritz Rabinowitz</td>
</tr>
<tr>
<td>18 April 1940</td>
<td>Hitler declares Norway a &quot;hostile country&quot; that can freely be exploited</td>
</tr>
<tr>
<td>24 April 1940</td>
<td>Hitler names Josef Terboven as Reichskommissar with power to invoke and enforce decrees</td>
</tr>
<tr>
<td>10 May 1940</td>
<td>All radios in the possession of Jews are ordered confiscated</td>
</tr>
<tr>
<td>25 September 1940</td>
<td>Terboven speaks to the Norwegian people, promising tolerance of all religions</td>
</tr>
<tr>
<td>4 December 1940</td>
<td>Moritz Rabinowitz is arrested by the Gestapo</td>
</tr>
<tr>
<td>16 January 1941</td>
<td>Brawl breaks out in Bergen when Nazis try to prevent Ernst Glaser from performing</td>
</tr>
<tr>
<td>1 March 1941</td>
<td>Benjamin Bild is arrested in Kjeller</td>
</tr>
<tr>
<td>21 April 1941</td>
<td>The synagogue in Trondheim is seized and vandalized</td>
</tr>
<tr>
<td>23 June 1941</td>
<td>Decree bans Jews from practicing law</td>
</tr>
<tr>
<td>23 June 1941</td>
<td>Sixty Jewish prisoners are imprisoned at Grini</td>
</tr>
<tr>
<td>10 October 1941</td>
<td>All Jews in Norway are ordered to submit their identification papers to be stamped with the letter &quot;J&quot;</td>
</tr>
<tr>
<td>26 December 1941</td>
<td>Benjamin Bild dies at Gross-Rosen</td>
</tr>
<tr>
<td>22 January 1942</td>
<td>&quot;Racial&quot; definitions of Jewish identity are formalized in Norway</td>
</tr>
<tr>
<td>28 January 1942</td>
<td>Hellmuth Reinhard arrives in Norway, taking charge of the Gestapo</td>
</tr>
<tr>
<td>1 February 1942</td>
<td>Quisling claims that the Norwegian constitution's paragraph 2's last clause is back in force, banning Jews from Norway</td>
</tr>
<tr>
<td>6 February 1942</td>
<td>All Jews are ordered to complete questionnaire in triplicate</td>
</tr>
<tr>
<td>27 February 1942</td>
<td>Moritz Rabinowitz is beaten to death in Sachsenhausen</td>
</tr>
<tr>
<td>7 March 1942</td>
<td>Four Jewish Norwegians are executed at Falstad concentration camp on trumped-up charges</td>
</tr>
<tr>
<td>21 August 1942</td>
<td>Nine Jews arrested in Nærnes, outside Oslo</td>
</tr>
<tr>
<td>6 October 1942</td>
<td>Martial law is declared in Trondheim; 34 Norwegians are murdered and all Jewish men over 15 are detained; women and children moved to two apartments</td>
</tr>
<tr>
<td>7 October 1942</td>
<td>Halldis Neegaard Østbye writes letter to Quisling proposing that Jews be killed &quot;quickly and painlessly&quot;</td>
</tr>
<tr>
<td>22 October 1942</td>
<td>Arne Hvam is shot by a member of the Norwegian resistance smuggling Jews out of Norway; a hunt throughout Østfold ensues</td>
</tr>
<tr>
<td>Date</td>
<td>Event Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>26 October 1942</td>
<td>Jewish men over 15 are arrested; all Jewish property is ordered confiscated</td>
</tr>
<tr>
<td>27 October 1942</td>
<td>Rakel and Jacob Feldmann are killed by border pilots at Skrikerudtjern</td>
</tr>
<tr>
<td>10 November 1942</td>
<td>Seven Church of Norway bishops submit a letter to Quisling protesting the persecution of Jews</td>
</tr>
<tr>
<td>13 November 1942</td>
<td>Three Jewish prisoners are shot at Falstad</td>
</tr>
<tr>
<td>19 November 1942</td>
<td>The MS Monte Rosa sails for Hamburg with 21 Jewish deportees; none survive</td>
</tr>
<tr>
<td>25 November 1942</td>
<td>The SS Donau is requisitioned for transport of Jews from Norway</td>
</tr>
<tr>
<td>26 November 1942</td>
<td>540 Jewish men, women, and children board the SS Donau, bound for Stettin</td>
</tr>
<tr>
<td>26 November 1942</td>
<td>The MS Monte Rosa sails for Hamburg with 26 Jewish deportees; 2 survive</td>
</tr>
<tr>
<td>1 December 1942</td>
<td>The prisoners on the Donau arrive at Auschwitz; most are sent to the gas chambers immediately</td>
</tr>
<tr>
<td>20 January 1943</td>
<td>Prominent Norwegians in Sweden implore the British government to intervene to save Norwegian Jews; they are rebuffed</td>
</tr>
<tr>
<td>24 February 1943</td>
<td>The Gotenland sails for Stettin with 158 Jewish prisoners; 6 survive</td>
</tr>
<tr>
<td>3 March 1943</td>
<td>The prisoners on the Gotenland arrive in Auschwitz; most are sent to the gas chambers immediately</td>
</tr>
<tr>
<td>8 May 1945</td>
<td>Norway is liberated</td>
</tr>
<tr>
<td>30 May 1945</td>
<td>Five of the Norwegian Holocaust survivors return to Norway</td>
</tr>
<tr>
<td>31 August 1945</td>
<td>Memorial service for the victims of the Holocaust held at the synagogue in Oslo</td>
</tr>
<tr>
<td>14 October 1947</td>
<td>The synagogue in Trondheim is rededicated</td>
</tr>
<tr>
<td>1 November 1948</td>
<td>Monument unveiled at Helsfyr cemetery in Oslo</td>
</tr>
<tr>
<td>6 May 1986</td>
<td>Monument honoring Moritz Rabinowitz unveiled in Haugesund</td>
</tr>
<tr>
<td>23 November 1997</td>
<td>Skarpnes commission submits report on financial loss to the Norwegian parliament</td>
</tr>
<tr>
<td>23 August 2006</td>
<td>Norwegian Center for Studies of Holocaust and Religious Minorities opens in Oslo</td>
</tr>
<tr>
<td>7 October 2006</td>
<td>Falstadsenteret opens</td>
</tr>
</tbody>
</table>

**Timeline of German history**
### 1st century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td></td>
<td>Battle of the Teutoburg Forest: An alliance of Germanic tribes ambushed and decisively destroyed three Roman legions and their auxiliaries, led by Publius Quinctilius Varus.</td>
</tr>
<tr>
<td>15</td>
<td></td>
<td>Battle at Pontes Longi</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>Battle of the Angrivarian Wall fought near Porta Westfalica between the Roman general Germanicus and an alliance of Germanic tribes commanded by Arminius.</td>
</tr>
<tr>
<td>16</td>
<td></td>
<td>Battle of Idistaviso fought between Roman legions commanded by Roman emperor Tiberius' heir and adopted son Germanicus, and an alliance of Germanic peoples commanded by Arminius.</td>
</tr>
</tbody>
</table>

### 3rd century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>235</td>
<td></td>
<td>Battle at the Harzhorn</td>
</tr>
<tr>
<td>260</td>
<td></td>
<td>The Romans make Cologne their capital city.</td>
</tr>
<tr>
<td>297</td>
<td></td>
<td>The Roman emperor allowed the Salian Franks to settle among the Batavi.</td>
</tr>
</tbody>
</table>

### 4th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>310</td>
<td></td>
<td>A bridge was constructed near Cologne.</td>
</tr>
<tr>
<td>313</td>
<td></td>
<td>The Roman Catholic Diocese of Cologne was founded.</td>
</tr>
<tr>
<td>314</td>
<td></td>
<td>The Roman Catholic Diocese of Mainz was founded.</td>
</tr>
<tr>
<td>357</td>
<td></td>
<td>The Battle of Strasbourg took place.</td>
</tr>
<tr>
<td>368</td>
<td></td>
<td>The Battle of Solicinium took place.</td>
</tr>
</tbody>
</table>

### 5th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>406</td>
<td>December 31</td>
<td>Battle of Mainz, Crossing of the Rhine</td>
</tr>
<tr>
<td>450</td>
<td></td>
<td>King Chlodio of the Salian Franks died.</td>
</tr>
</tbody>
</table>
Chlodio’s son Merovech became king of the Salian Franks with the support of the Western Roman dux Flavius Aetius.

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>451</td>
<td>20 June</td>
<td><strong>Battle of the Catalaunian Plains</strong>: The Franks joined a coalition led by the Western Roman Empire which defeated the Huns in modern northeastern France.</td>
</tr>
<tr>
<td>457</td>
<td></td>
<td>Merovech died. He was succeeded as king of the Salian Franks by his son Childeric I.</td>
</tr>
<tr>
<td>463</td>
<td></td>
<td><strong>Battle of Orleans (463)</strong>: The Salian Franks and forces loyal to the <em>magister militum</em> Aegidius defeated an attack by the Visigothic Kingdom at Orléans.</td>
</tr>
<tr>
<td>481</td>
<td></td>
<td>Childeric died. He was succeeded as king of the Salian Franks by his son Clovis I.</td>
</tr>
<tr>
<td>486</td>
<td></td>
<td><strong>Battle of Soissons (486)</strong>: An alliance of Franks led by Clovis defeated the Kingdom of Soissons. Syagrius, the king of Soissons and son of Aegidius, fled to the Visigothic Kingdom. The Visigoths surrendered Syagrius to the Salian Franks to be executed.</td>
</tr>
<tr>
<td>496</td>
<td></td>
<td><strong>Battle of Tolbiac</strong>: A Frankish force under Clovis defeated the Alemanni in modern Zülpich. The former credited his victory to Jesus.</td>
</tr>
<tr>
<td>500</td>
<td></td>
<td>Clovis was baptized Catholic at Reims. Clovis commissioned the Salic Law, the first written code of civil law among the Franks. The law forbade women from inheriting land.</td>
</tr>
</tbody>
</table>

**6th century**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>507</td>
<td></td>
<td><strong>Battle of Vouillé</strong>: A Frankish force led by Clovis defeated the Visigothic Kingdom at Vouillé. The Visigothic king Alaric II was killed. Clovis annexed Aquitaine.</td>
</tr>
<tr>
<td>508</td>
<td></td>
<td>Clovis was crowned king of the Franks with his capital at Paris.</td>
</tr>
<tr>
<td>511</td>
<td>28 November</td>
<td><strong>First Council of Orléans</strong>: A synod of Catholic bishops called by Clovis at Orléans granted some legal powers and immunities to the Catholic Church. Clovis died. His domain was split among his four sons Theuderic I, Chlodomer, Childebert I and Chlothar I the Old, who became kings ruling at Reims, Orléans, Paris, and Soissons, respectively.</td>
</tr>
<tr>
<td>524</td>
<td>25 June</td>
<td><strong>Battle of Vézeronce</strong>: A Frankish invasion of Burgundy was halted near modern Vézeronce-Curtin. The Burgundian king Sigismund of Burgundy was captured and Chlodomer was killed. Chlodomer’s wife Guntheuc married Chlothar. Chlothar had two of Chlodomer’s sons killed. The third, Clodoald, fled to Provence.</td>
</tr>
<tr>
<td>531</td>
<td></td>
<td><strong>Battle of the Unstrut River (531)</strong>: Theuderic conquered the Thuringii near the Unstrut.</td>
</tr>
<tr>
<td>532</td>
<td></td>
<td><strong>Battle of Autun</strong>: Childebert and Chlothar defeated Burgundy near Autun.</td>
</tr>
<tr>
<td>534</td>
<td></td>
<td>Theuderic died. His son Theudebert I inherited his throne. The Burgundian king Godomar was killed by Frankish forces.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
<td></td>
</tr>
<tr>
<td>-----------</td>
<td>----------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>30 April</td>
<td>The pro-Byzantine regent of the Ostrogothic Kingdom, Amalasuntha, was murdered on the orders of her cousin and coregent Theodahad.</td>
<td></td>
</tr>
<tr>
<td></td>
<td><em>Gothic War (535–554)</em>: The Byzantine Empire invaded the Ostrogothic Kingdom.</td>
<td></td>
</tr>
<tr>
<td>535</td>
<td><em>Council of Clermont (535)</em>: A synod was held in modern Clermont-Ferrand which limited the rights of Catholic bishops to appeal to the state and which condemned marriage between Christians and Jews and between relatives.</td>
<td></td>
</tr>
<tr>
<td>539</td>
<td><em>Gothic War (535–554)</em>: Frankish forces under Theudebert I drove Byzantine and Ostrogothic armies from their encampments on the Po. November</td>
<td></td>
</tr>
<tr>
<td>539</td>
<td><em>Gothic War (535–554)</em>: The Frankish army on the Po, suffering from dysentery, surrendered to the Byzantines.</td>
<td></td>
</tr>
<tr>
<td>548</td>
<td>Theudebert I died. His son Theudebald inherited his kingdom.</td>
<td></td>
</tr>
<tr>
<td>549</td>
<td>October <em>Fifth Council of Orléans</em>: A synod presided over by Sacerdos of Lyon in Orléans condemned Nestorianism and simony.</td>
<td></td>
</tr>
<tr>
<td>554</td>
<td><em>Battle of the Volturnus (554)</em>: A Byzantine force cut off and destroyed a joint Frankish-Ostrogothic army at their camp on the Volturno.</td>
<td></td>
</tr>
<tr>
<td>555</td>
<td>Theudebald died, childless. His kingdom passed to Chlothar.</td>
<td></td>
</tr>
<tr>
<td>558</td>
<td>13 December *Childebert I died without male heirs. Chlothar inherited his kingdom.</td>
<td></td>
</tr>
<tr>
<td>560</td>
<td>December Conomor, king of Domnonée, who had allied with Chlothar's son Chram against him, was killed in battle by Chlothar's forces.</td>
<td></td>
</tr>
<tr>
<td>561</td>
<td>Chram was captured and executed.</td>
<td></td>
</tr>
<tr>
<td>567</td>
<td>29 November Chlothar died of pneumonia. His kingdom was divided among his surviving sons Charibert I, Guntram, Sigebert I and Chilperic I.</td>
<td></td>
</tr>
<tr>
<td>575</td>
<td>December Charibert I died. His kingdom was divided among his brothers Guntram, Chilperic I and Sigebert I, the latter of whose domains become known as Austrasia, the eastern land, with its capital at Metz.</td>
<td></td>
</tr>
<tr>
<td>577</td>
<td>Sigebert I died. He was succeeded by his young son Childebert II, with his wife Brunhilda of Austrasia acting as regent.</td>
<td></td>
</tr>
<tr>
<td>584</td>
<td>September Chilperic I was stabbed to death. His infant son Chlothar II the Great, the Young inherited his kingdom under the regency of his mother Fredegund.</td>
<td></td>
</tr>
<tr>
<td>587</td>
<td>Guntram and Brunhilda agreed to the Treaty of Andelot, according to which the former adopted Childebert II as his son and heir.</td>
<td></td>
</tr>
<tr>
<td>591</td>
<td>Childebert II appointed Tassilo I of Bavaria king of Bavaria.</td>
<td></td>
</tr>
<tr>
<td>592</td>
<td>28 January Guntram died. His kingdom passed to Childebert II.</td>
<td></td>
</tr>
</tbody>
</table>
Childebert II died. Austrasia was divided between his two sons Theudebert II and Theuderic II.

Theudebert II expelled Brunhilda from his kingdom.

Theuderic II declared war on Theudebert II.

### 7th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>602</td>
<td></td>
<td>The Duchy of Gascony was created as a buffer state against the Vascones and the Visigothic Kingdom.</td>
</tr>
<tr>
<td>612</td>
<td></td>
<td>Theuderic II captured Theudebert II in battle in modern Zülpich.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Theudebert II was killed in captivity along with his son on Brunhilda's orders. Theuderic II inherited his kingdom as king of unified Austrasia.</td>
</tr>
<tr>
<td>613</td>
<td></td>
<td>Theuderic II died of dysentery. His young bastard son Sigebert II became king of Austrasia under the regency of Brunhilda.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chlothar the Great invaded Austrasia. The Austrasian mayor of the palace Warnachar II recognized him as regent and ordered the army not to resist.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Brunhilda, Sigebert II and Sigebert's brother were executed on Chlothar the Great's orders. The latter annexed Austrasia.</td>
</tr>
<tr>
<td>614</td>
<td>18 October</td>
<td>Chlothar the Great issued the Edict of Paris. Among its provisions, the edict banned Jews from holding royal office and granted the nobility the exclusive power to appoint royal officers.</td>
</tr>
<tr>
<td>617</td>
<td></td>
<td>Chlothar the Great made the office of the mayor of the palace a lifetime appointment.</td>
</tr>
<tr>
<td>623</td>
<td></td>
<td>Chlothar the Great donated Austrasia to his son Dagobert I.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dagobert I took Arnulf of Metz, the bishop of the Roman Catholic Diocese of Metz, as an adviser and appointed the Austrasian noble Pepin of Landen his mayor of the palace.</td>
</tr>
<tr>
<td>629</td>
<td>18 October</td>
<td>Chlothar the Great died.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dagobert I laid claim to Chlothar the Great's territory with the exception of Aquitaine, which he left to his half-brother Charibert II.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dagobert I dismissed Pepin of Landen as mayor of the palace.</td>
</tr>
<tr>
<td>631</td>
<td></td>
<td>Battle of Wogastisburg: An invading Frankish army was defeated by Samo's Empire.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Dagobert I established the Duchy of Thuringia on the former territory of the Thuringii.</td>
</tr>
<tr>
<td>632</td>
<td></td>
<td>Charibert II was killed on the orders of Dagobert I.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Charibert II's infant son Chilperic of Aquitaine was killed on the orders of Dagobert I, who established the Duchy of Aquitaine on his territories with the patrician Felix of Aquitaine as duke.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
<td>Details</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>634 January</td>
<td>Dagobert I ceded Austrasia to his young son Sigebert III, with Adalgisel acting as coregent and mayor of the palace of Austrasia and the bishop Cunibert acting as coregent.</td>
<td>The nobility of Austrasia joined a revolt led by Pepin of Landen.</td>
</tr>
<tr>
<td>639 19 January</td>
<td>Dagobert I died. His kingdom passed to his young son Clovis II, with his wife Nanthild acting as regent.</td>
<td>Pepin of Landen replaced Adalgisel as mayor of the palace of Austrasia.</td>
</tr>
<tr>
<td>640 27 February</td>
<td>Pepin of Landen died.</td>
<td>Otto (mayor of the palace) was appointed mayor of the palace of Austrasia.</td>
</tr>
<tr>
<td>643</td>
<td>Otto was murdered by duke Leuthari II on the orders of Pepin of Landen's son Grimoald the Elder, who succeeded him as mayor of the palace of Austrasia.</td>
<td></td>
</tr>
<tr>
<td>650</td>
<td>Synod of Rouen: A Catholic synod was held in Rouen which again condemned simony.</td>
<td></td>
</tr>
<tr>
<td>656 1 February</td>
<td>Sigebert III died. Grimoald the Elder tonsured Sigebert's son Dagobert II and declared his own son Childebert the Adopted, whom Sigebert III had adopted while still childless, king of Austrasia.</td>
<td></td>
</tr>
<tr>
<td>657 27 November</td>
<td>Clovis II died. His kingdom passed to his young son Chlothar III, under the regency of his wife Balthild.</td>
<td></td>
</tr>
<tr>
<td>661</td>
<td>Chlothar III conquered Austrasia and executed Grimoald the Elder and Childebert the Adopted.</td>
<td></td>
</tr>
<tr>
<td>662</td>
<td>Chlothar III ceded Austrasia to his young brother Childeric II and appointed Wulfoald his regent and mayor of the palace.</td>
<td></td>
</tr>
<tr>
<td>673</td>
<td>Chlothar III died. His younger brother Theuderic III inherited his kingdom with the support of his mayor of the palace Ebroin.</td>
<td>Childeric II invaded and annexed Theuderic III's kingdom.</td>
</tr>
<tr>
<td>675</td>
<td>Childeric II was killed along with his wife Bilichild and a son, Dagobert, by a conspiracy of nobles.</td>
<td>Theuderic III reclaimed his kingdom.</td>
</tr>
<tr>
<td></td>
<td>Theuderic III became king of Austrasia.</td>
<td>Clovis III became king of Austrasia.</td>
</tr>
<tr>
<td>676</td>
<td>Clovis III died.</td>
<td></td>
</tr>
<tr>
<td>679 23 December</td>
<td>Dagobert II was murdered, probably on Ebroin's orders. Theuderic III inherited his kingdom.</td>
<td></td>
</tr>
<tr>
<td>680</td>
<td>Wulfoald died.</td>
<td></td>
</tr>
<tr>
<td>687</td>
<td>Battle of Tertry: Austrasian forces loyal to Pepin of Herstal defeated the invading army of Theuderic III at modern Tertry, Somme. Pepin of Herstal accepted Theuderic's unification</td>
<td></td>
</tr>
</tbody>
</table>
of the Frankish kingdoms on the condition that he replace Berthar as his mayor of the palace.

Pepin of Herstal took the title Duke of the Franks.

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>690</td>
<td></td>
<td><strong>Battle of Dorestad</strong>: A Frankish force conquered Dorestad from the Frisian Kingdom.</td>
</tr>
<tr>
<td>691</td>
<td></td>
<td>Theuderic III died. He was succeeded by his young son Clovis IV.</td>
</tr>
<tr>
<td>695</td>
<td></td>
<td>Clovis IV died. He was succeeded by his young brother Childebert III the Just.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pepin of Herstal appointed his sons Drogo of Champagne and Grimoald the Younger mayors of the palaces in Neustria and Burgundy, respectively.</td>
</tr>
</tbody>
</table>

8th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>708</td>
<td></td>
<td>Drogo died.</td>
</tr>
<tr>
<td>711</td>
<td>23 April</td>
<td>Childebert the Just died. His young son Dagobert III succeeded him as king of the Franks.</td>
</tr>
<tr>
<td>714</td>
<td></td>
<td>Grimuald the Younger was assassinated.</td>
</tr>
<tr>
<td>16 December</td>
<td>Pepin of Herstal died. His son Theudoald succeeded him as mayor of the palace of Austrasia and in the west, with his mother Plectrude as regent.</td>
<td></td>
</tr>
<tr>
<td>716</td>
<td></td>
<td>Dagobert III appointed Ragenfrid mayor of the palace in the west.</td>
</tr>
<tr>
<td>26 September</td>
<td>Battle of Compiègne: Forces loyal to Ragenfrid defeated an army loyal to the young Theudoald, forcing him to flee to Cologne.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Pepin of Herstal's illegitimate son Charles Martel was acclaimed mayor of the palace of Austrasia by the Austrasian nobility.</td>
</tr>
<tr>
<td>715</td>
<td></td>
<td>Dagobert III died. He was succeeded by Chilperic II, his cousin and a son of Childeric II.</td>
</tr>
<tr>
<td>716</td>
<td></td>
<td><strong>Battle of Cologne</strong>: A Frisian army joined by the forces of Chilperic II conquered Cologne in Austrasia, forcing Charles to flee to the Eifel and compelling Plectrude to accept Chilperic II as king.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Battle of Amblève</strong>: Charles defeated the forces of Frisia and Chilperic II at Amel.</td>
</tr>
<tr>
<td>717</td>
<td>21 March</td>
<td><strong>Battle of Vincy</strong>: Charles dealt Chilperic II a decisive defeat at modern Les Rues-des-Vignes and subsequently declared Chlothar IV king of Austrasia.</td>
</tr>
<tr>
<td>718</td>
<td></td>
<td><strong>Battle of Soissons (718)</strong>: Charles defeated the armies of Chilperic II and Aquitaine at Soissons. Chilperic II fled to Aquitaine.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Charles recognized Chilperic II as king of the Franks in exchange for his appointment as mayor of the palace with extensive powers.</td>
</tr>
<tr>
<td>719</td>
<td></td>
<td>Chlothar IV died.</td>
</tr>
<tr>
<td>721</td>
<td>13 February</td>
<td>Chilperic II died. He was succeeded by Dagobert III's son Theuderic IV.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Battle of Toulouse (721)</strong>: An Aquitainian force broke an Umayyad siege of Toulouse.</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
<td>Description</td>
</tr>
<tr>
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</tr>
<tr>
<td>732</td>
<td>Battle of the River Garonne</td>
<td>An Umayyad army wiped out an Aquitainian force on the Garonne.</td>
</tr>
<tr>
<td>734</td>
<td>Battle of the Boarn</td>
<td>A Frankish army led by Charles defeated and annexed the Frisian Kingdom and killed its king, Bubo, Duke of the Frisians.</td>
</tr>
<tr>
<td>736</td>
<td>Battle of Nîmes</td>
<td>Charles destroyed the Umayyad Septimanian cities of Nîmes, Agde, Béziers and what is now Villeneuve-lès-Maguelone.</td>
</tr>
<tr>
<td>737</td>
<td>Battle of Avignon</td>
<td>Charles breached and burned the Umayyad-held city of Avignon.</td>
</tr>
<tr>
<td></td>
<td>Battle of Narbonne (737)</td>
<td>Charles besieged but failed to capture the Umayyad-held city of Narbonne.</td>
</tr>
<tr>
<td></td>
<td>Battle of the River Berre</td>
<td>Charles intercepted and destroyed an Umayyad army sent to relieve his siege of Narbonne near the Étang de Berre.</td>
</tr>
<tr>
<td>737</td>
<td>Theuderic IV died</td>
<td>Charles prevented his succession.</td>
</tr>
<tr>
<td>740</td>
<td></td>
<td>Charles divided his lands between his two elder sons Carloman and Pepin the Short, the former ruling as king in the east and the latter in the west.</td>
</tr>
<tr>
<td>741</td>
<td>22 October</td>
<td>Charles died.</td>
</tr>
<tr>
<td>742</td>
<td>21 April</td>
<td>Concilium Germanicum: A synod called by Carloman and presided over by Saint Boniface settled some issues of Catholic ritual and organization. The Rule of Saint Benedict became mandatory in Frankish monasteries.</td>
</tr>
<tr>
<td>743</td>
<td></td>
<td>Childeric III was appointed king of the Franks.</td>
</tr>
<tr>
<td>746</td>
<td></td>
<td>Council of Cannstatt: Carloman executed the Alemanni nobility, numbering in the thousands, in modern Stuttgart.</td>
</tr>
<tr>
<td>747</td>
<td>15 August</td>
<td>Carloman retired to live as a monk in Rome. His son Drogo succeeded him as mayor of the palace.</td>
</tr>
<tr>
<td>751</td>
<td>March</td>
<td>The pope Pope Zachary deposed Childeric III as king of the Franks at the urging of Pepin the Short. An assembly of Frankish nobles elected Pepin the Short king.</td>
</tr>
<tr>
<td>752</td>
<td>Siege of Narbonne (752–59)</td>
<td>Pepin the Short laid siege to Narbonne, still held by forces loyal to Yusuf ibn 'Abd al-Rahman al-Fihri, governor of Al-Andalus under the defunct Umayyad Caliphate.</td>
</tr>
<tr>
<td>753</td>
<td></td>
<td>Drogo was tonsured and forced to live in a monastery.</td>
</tr>
<tr>
<td>755</td>
<td></td>
<td>Pepin the Short closed or nationalized the private mints and fixed pence and shillings to the silver French denier.</td>
</tr>
<tr>
<td>756</td>
<td></td>
<td>Pepin the Short gave the Donation of Pepin, territories ceded by the Kingdom of the</td>
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<tr>
<td>Year</td>
<td>Event</td>
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<tr>
<td>759</td>
<td>Lombards under military pressure, to the pope, Pope Stephen II.</td>
<td></td>
</tr>
<tr>
<td>768</td>
<td>Siege of Narbonne (752–59): The defenders of Narbonne opened the city gates to the Franks.</td>
<td></td>
</tr>
<tr>
<td>770</td>
<td>Charlemagne married Desiderata of the Lombards, a daughter of Desiderius, the king of the Kingdom of the Lombards.</td>
<td></td>
</tr>
<tr>
<td>771</td>
<td>Carloman I died. His widow Gerberga, wife of Carloman I fled with his two sons to the Kingdom of the Lombards. Charlemagne repudiated his marriage to Desiderata.</td>
<td></td>
</tr>
<tr>
<td>772</td>
<td>Pope Stephen III died. Pope Adrian I was elected to succeed him as pope. Adrian demanded that Desiderius cede to the Papal States the territory surrendered in 756. Saxon Wars: Charlemagne invaded the territory of the Saxons and destroyed their sacred symbol Irminsul near Paderborn.</td>
<td></td>
</tr>
<tr>
<td>773</td>
<td>September Siege of Pavia (773–74): Charlemagne laid siege to the Lombard capital Pavia.</td>
<td></td>
</tr>
<tr>
<td>774</td>
<td>June Siege of Pavia (773–74): Desiderius opened the gates of Pavia and surrendered to Charlemagne. 10 July Charlemagne was crowned with the Iron Crown of Lombardy king of the Lombards at Pavia.</td>
<td></td>
</tr>
<tr>
<td>776</td>
<td>Charlemagne established the March of Friuli on the territory of the old Duchy of Friuli.</td>
<td></td>
</tr>
<tr>
<td>781</td>
<td>15 April Charlemagne appointed his son Pepin of Italy king of Italy.</td>
<td></td>
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<tr>
<td>782</td>
<td>October Massacre of Verden: Charlemagne had some forty-five hundred Saxon captives murdered at modern Verden an der Aller.</td>
<td></td>
</tr>
<tr>
<td>785</td>
<td>Saxon Wars: The Saxon leader Widukind converted to Christianity and pledged fealty to Charlemagne. Charlemagne issued the Capitulatio de partibus Saxoniae, a legal code which, among other clauses, prescribed the death penalty for any Saxons who refused to convert to Christianity. Council of Paderborn: A council held at Paderborn outlawed idolatry and called for the death penalty for anyone who had caused another to be executed for witchcraft.</td>
<td></td>
</tr>
<tr>
<td>789</td>
<td>Charlemagne issued the Admonitio generalis, reforming the Christian liturgy in his empire and calling for the establishment of schools.</td>
<td></td>
</tr>
<tr>
<td>795</td>
<td>Charlemagne established the Marca Hispanica between the Pyrenees and the Ebro.</td>
<td></td>
</tr>
<tr>
<td>799</td>
<td>Siege of Trsat: Eric of Friuli, the duke of Friuli and an officer of Charlemagne, was killed during a failed siege of Trsat, in Croatia.</td>
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<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>26 December</td>
<td>The pope Pope Leo III was assaulted in Rome and nearly mutilated before his rescue and flight to the Duchy of Spoleto.</td>
<td></td>
</tr>
<tr>
<td>800 November</td>
<td>Charlemagne arrived in Rome.</td>
<td></td>
</tr>
<tr>
<td>23 December</td>
<td>Leo took an oath of innocence of the charges of his political enemies. Charlemagne ordered them exiled.</td>
<td></td>
</tr>
<tr>
<td>25 December</td>
<td>Leo crowned Charlemagne Holy Roman Emperor.</td>
<td></td>
</tr>
</tbody>
</table>

**9th century**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>802</td>
<td></td>
<td>Charlemagne issued the <em>Capitularia missorum specialia</em>, defining the office of the <em>missus dominicus</em>, a salaried emissary to the kingdom.</td>
</tr>
<tr>
<td>803</td>
<td></td>
<td>Charlemagne issued the <em>Lex Saxonum</em>, allowing Saxon customs which were not contradictory to Christianity and granting some rights and protections to the church in the Saxon lands.</td>
</tr>
<tr>
<td>804</td>
<td></td>
<td>Charlemagne organized the Duchy of Saxony on the territories of the conquered Saxons.</td>
</tr>
<tr>
<td>810</td>
<td>8 July</td>
<td>Pepin of Italy died. He was succeeded as king of Italy by his illegitimate son Bernard of Italy.</td>
</tr>
<tr>
<td>811</td>
<td></td>
<td>Charlemagne and Hemming of Denmark, the king of Denmark, signed the Treaty of Heiligen, promising peace and fixing their border at the Eider.</td>
</tr>
<tr>
<td>812</td>
<td></td>
<td>Charlemagne established the March of Tuscany.</td>
</tr>
<tr>
<td>813</td>
<td>13 September</td>
<td>Charlemagne crowned his son Louis the Pious, the Fair, the Debonaire co-Holy Roman Emperor.</td>
</tr>
<tr>
<td>814</td>
<td>28 January</td>
<td>Charlemagne died.</td>
</tr>
<tr>
<td>816</td>
<td></td>
<td><em>Battle of Pancorbo (816)</em>: Forces loyal to the Frankish vassal Velasco the Gascon were routed by the Emirate of Córdoba at Pancorbo.</td>
</tr>
<tr>
<td>August</td>
<td></td>
<td><em>Synods of Aachen (816–819)</em>: A synod was called at the Palace of Aachen in Aachen which would conform monks to the Rule of Saint Benedict and separate them from canons, who were called to live according to the <em>Institutio canonicorum Aquisgranensis</em>.</td>
</tr>
<tr>
<td>817</td>
<td></td>
<td>Louis the Pious appointed his son Pepin I of Aquitaine king of Aquitaine, his son Louis the German king of Bavaria, and his son Lothair I co-Holy Roman Emperor with the promise of receiving his other domains.</td>
</tr>
<tr>
<td>818</td>
<td>17 April</td>
<td>Bernard died, two days after being blinded with a hot poker on Louis the Pious's orders. Lothair I inherited Italy.</td>
</tr>
<tr>
<td>819</td>
<td></td>
<td>Louis the Pious issued the <em>Notitia de servitio monasteriorum</em>, which listed monasteries in his kingdom and the services they owed the crown.</td>
</tr>
<tr>
<td>823</td>
<td>5 April</td>
<td>Lothair I was crowned Holy Roman Emperor in Rome by the pope Pope Paschal I.</td>
</tr>
<tr>
<td>824</td>
<td></td>
<td><em>Battle of Roncevaux Pass (824)</em>: A combined Basque-Banu Qasi force defeated</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>829</td>
<td>Louis the Pious promised the inheritance of Alamannia to his son Charles the Bald.</td>
<td></td>
</tr>
<tr>
<td>830 May</td>
<td>A rebellion of Pepin I of Aquitaine, Louis the German and Lothair I, instigated in part by Wala of Corbie, the abbot of Corbie Abbey, captured their father Louis the Pious at Compiègne and forced their stepmother, Charles the Bald's mother Judith of Bavaria (died 843), into a nunnery. Pepin I of Aquitaine and Louis the German declared their loyalty to their father Louis the Pious against Lothair I in exchange for the promise of a greater portion of his inheritance. Wala was deposed as abbot of Corbie Abbey and Judith returned to her husband's court.</td>
<td></td>
</tr>
<tr>
<td>832</td>
<td>Louis the Pious declared Charles the Bald king of Aquitaine and promised Lothair I the rest of his kingdom in the face of an uprising by Pepin I of Aquitaine and Louis the German.</td>
<td></td>
</tr>
<tr>
<td>833</td>
<td>Lothair I joined the rebellion of his brothers Pepin I of Aquitaine and Louis the German against his father Louis the Pious.</td>
<td></td>
</tr>
<tr>
<td>13 November</td>
<td>Louis the Pious met his sons Pepin I of Aquitaine, Louis the German and Lothair I and their armies, as well as the pope, Pope Gregory IV, at the Field of Lies near Colmar. Ebbo, archbishop of the archdiocese of Reims, presided over a synod in Soissons which deposed Louis the Pious as Holy Roman Emperor.</td>
<td></td>
</tr>
<tr>
<td>834 1 April</td>
<td>Louis the Pious was restored as Holy Roman Emperor with the support of the Frankish nobility.</td>
<td></td>
</tr>
<tr>
<td>835 2 February</td>
<td>Synod of Thionville: Ebbo publicly recanted his charges against Louis the Pious at a synod at Thionville.</td>
<td></td>
</tr>
<tr>
<td>836</td>
<td>Louis the Pious appointed Lothair I king only of Italy; all else was divided between Pepin I of Aquitaine, Louis the German and Charles the Bald.</td>
<td></td>
</tr>
<tr>
<td>837</td>
<td>Louis the Pious crowned Charles the Bald king of Alamannia and Burgundy, granting him some lands which were before promised to Louis the German. Louis the German rose in revolt; Louis the Pious responded by promising all his lands save Bavaria to Charles the Bald.</td>
<td></td>
</tr>
<tr>
<td>838 13 December</td>
<td>Pepin I of Aquitaine died. Louis the Pious appointed Charles the Bald king of Aquitaine.</td>
<td></td>
</tr>
<tr>
<td>839</td>
<td>The Aquitainian nobility rebelled in favor of Pepin I of Aquitaine's son Pepin II the Younger of Aquitaine. Louis the German invaded Swabia.</td>
<td></td>
</tr>
<tr>
<td>840</td>
<td>Louis the Pious and Lothair I agreed to a division of the empire after the former's death, with Charles the Bald inheriting the western part and Lothair I inheriting the eastern, including Italy. Defeated by the forces of Louis the Pious and Lothair I, the Aquitainian nobility accepted Charles the Bald as king of Aquitaine. Louis the Pious and Lothair I defeated the armies of Louis the German.</td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Lothair I and Pietro Tradonico, doge of the Republic of Venice, signed the Pactum Lotharii,</td>
<td></td>
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<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>February</td>
<td>reiterating earlier agreements between the Franks and the Byzantine Empire.</td>
<td></td>
</tr>
<tr>
<td>20 June</td>
<td>Louis the Pious died. Lothair I claimed the whole inheritance of his territories as Holy Roman Emperor.</td>
<td></td>
</tr>
<tr>
<td>841</td>
<td>25 June <em>Battle of Fontenoy</em>: The forces of Charles the Bald and Louis the German dealt a decisive defeat to Lothair I and Pepin the Younger at Fontenoy.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>An uprising began among Saxon peasants who called themselves the <em>Stellinga</em>.</td>
<td></td>
</tr>
<tr>
<td>842</td>
<td>12 February Louis the German and Charles the Bald took the Oaths of Strasbourg, in which each pledged to aid the other against Lothair I. Their soldiers pledged not to obey an order counter to this oath.</td>
<td></td>
</tr>
<tr>
<td>843</td>
<td>August The Treaty of Verdun was signed, ending the war between Charles the Bald, Lothair I, and Louis the German, who received West Francia, Middle Francia, and East Francia, respectively. Lothair I retained the title Holy Roman Emperor.</td>
<td></td>
</tr>
<tr>
<td>844</td>
<td>15 June Lothair I's son Louis II of Italy was crowned Holy Roman Emperor jointly with his father in Rome by the pope Pope Sergius II.</td>
<td></td>
</tr>
<tr>
<td>855</td>
<td>19 September Lothair I and his sons signed the Treaty of Prüm in Schüller. On his death Louis II of Italy was to become Holy Roman Emperor and king of Italy, Lothair II king of Lotharingia, and Charles of Provence king of the rest of his domains.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>29 September Lothair I died.</td>
<td></td>
</tr>
<tr>
<td>869</td>
<td>8 August Lothair II died. Lotharingia passed to his brother Louis II, at that time away at war with the Emirate of Bari.</td>
<td></td>
</tr>
<tr>
<td>870</td>
<td>8 August Louis the German and Charles the Bald signed the Treaty of Meersen, under which they agreed to partition Lotharingia between themselves.</td>
<td></td>
</tr>
<tr>
<td>875</td>
<td>12 August Louis II died. He left Italy and the title of Holy Roman Emperor to his cousin, Louis the German's son Carloman of Bavaria. Charles the Bald was crowned king of Italy at Pavia with the Iron Crown of Lombardy with the support of the pope Pope John VIII.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>29 December Charles the Bald was crowned Holy Roman Emperor in Rome by the pope Pope John VIII.</td>
<td></td>
</tr>
<tr>
<td>876</td>
<td>28 August Louis the German died. His kingdom was divided along ethnic lines among his sons Carloman of Bavaria, Louis the Younger and Charles the Fat, who received, roughly, Bavaria, Saxony, and Swabia, respectively. Carloman of Bavaria appointed his illegitimate son Arnulf of Carinthia duke of Carinthia.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>8 October <em>Battle of Andernach (876)</em>: Louis the Younger defeated an attempted West Frankish invasion of East Francia across the Rhine near Andernach.</td>
<td></td>
</tr>
<tr>
<td>877</td>
<td>6 October Charles the Bald died. Carloman of Bavaria conquered Italy. West Francia Passed to his son, Louis the Stammerer.</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Month</td>
<td>Event</td>
</tr>
<tr>
<td>------</td>
<td>-------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>879</td>
<td>November</td>
<td>Carloman of Bavaria was incapacitated, probably by a stroke. Carloman of Bavaria abdicated Bavaria and Italy to his brothers Louis the Younger and Charles the Fat, respectively.</td>
</tr>
<tr>
<td>880</td>
<td>February</td>
<td>Battle of Thimeon: Louis the Younger destroyed a Viking camp near modern Charleroi. Louis the Younger signed the Treaty of Ribemont with Louis III of France and Carloman II, kings ruling jointly in West Francia, recognizing some territorial gains he had made in Lotharingia.</td>
</tr>
<tr>
<td>881</td>
<td>February</td>
<td>Charles the Fat was crowned Holy Roman Emperor by the pope Pope John VIII.</td>
</tr>
<tr>
<td>882</td>
<td>January</td>
<td>Louis the Younger died. His brother Charles the Fat inherited his kingdom. Siege of Asselt: The Viking leader Godfrid, Duke of Frisia was besieged in his camp in the valley of the Meuse by East Frankish forces. After converting to Christianity he was granted the Kennemerland as a vassal of Charles the Fat. Wilhelminer War: The Wilhelminers rebelled against Aribo of Austria, the margrave of the East Frankish March of Pannonia. Wilhelminer War: The Wilhelminers paid homage to Arnulf of Carinthia in exchange for his support against Aribo. Frankish-Moravian War: Svatopluk I of Moravia, the king of Great Moravia, intervened in Pannonia on the side of Aribo.</td>
</tr>
<tr>
<td>884</td>
<td>December</td>
<td>King Carloman II of West Francia died on a hunting expedition. His cousin Charles the Fat inherited his kingdom.</td>
</tr>
<tr>
<td>886</td>
<td>October</td>
<td>Siege of Paris (885–86): The army of Charles the Fat arrived in Paris. He allowed the Viking fleet to sail to Burgundy, then in revolt.</td>
</tr>
<tr>
<td>887</td>
<td>November</td>
<td>An assembly of East Frankish nobles at Trebur deposed Charles the Fat in favor of his nephew Arnulf of Carinthia. Berengar I of Italy, the margrave of Friulu, was crowned king of Italy at Pavia by the Italian nobility.</td>
</tr>
<tr>
<td>888</td>
<td>January</td>
<td>Charles the Fat died. The nobility in Upper Burgundy elected Rudolph I of Burgundy king.</td>
</tr>
<tr>
<td>891</td>
<td>February</td>
<td>The pope Pope Stephen V crowned Guy III of Spoleto, his preferred claimant to the throne of Italy, Holy Roman Emperor. Battle of Leuven (891): An East Frankish force repelled a Viking invasion at modern Leuven.</td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>892</td>
<td>30 April</td>
<td>Guy's son Lambert of Italy was crowned co-Holy Roman Emperor with his father at Ravenna by the pope, Pope Formosus.</td>
</tr>
<tr>
<td>894</td>
<td>12 December</td>
<td>Guy died.</td>
</tr>
<tr>
<td>895</td>
<td></td>
<td>Arnulf of Carinthia appointed his illegitimate son Zwentibold king of Lotharingia.</td>
</tr>
<tr>
<td>896</td>
<td>21 February</td>
<td>Arnulf of Carinthia, joined by Berengar, conquered Rome from Lambert and freed the pope Pope Formosus from his imprisonment in the Castel Sant'Angelo.</td>
</tr>
<tr>
<td></td>
<td>22 February</td>
<td>The pope Pope Formosus crowned Arnulf of Carinthia Holy Roman Emperor.</td>
</tr>
<tr>
<td>899</td>
<td>8 December</td>
<td>Arnulf of Carinthia died. His young son Louis the Child succeeded him as king of East Francia.</td>
</tr>
<tr>
<td>900</td>
<td></td>
<td><em>Hungarian conquest of the Carpathian Basin:</em> Hungary conquered the Great Hungarian Plain and the March of Pannonia.</td>
</tr>
<tr>
<td></td>
<td>13 August</td>
<td>Zwentibold was killed by Reginar, Duke of Lorraine. His young half-brother Louis the Child inherited his kingdom.</td>
</tr>
<tr>
<td></td>
<td>12 October</td>
<td>The king of Provence Louis the Blind conquered Pavia from Berengar, and had himself crowned there king of Italy with the Iron Crown of Lombardy.</td>
</tr>
<tr>
<td>10th century</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>901</td>
<td>22 February</td>
<td>Louis the Blind was crowned Holy Roman Emperor by the pope Pope Benedict IV.</td>
</tr>
<tr>
<td>903</td>
<td></td>
<td>Louis the Child issued the Raffelstetten customs regulations, regulating customs on a bridge in modern Asten.</td>
</tr>
<tr>
<td>905</td>
<td>21 July</td>
<td>Berengar ordered Louis the Blind stripped of his royal Italian and imperial titles and blinded in Verona.</td>
</tr>
<tr>
<td>907</td>
<td>6 July</td>
<td><em>Battle of Pressburg:</em> An East Frankish army was wiped out by a Hungarian force at modern Bratislava during an attempted reconquest of Pannonia.</td>
</tr>
<tr>
<td>908</td>
<td>3 August</td>
<td><em>Battle of Eisenach (908):</em> An East Frankish army was dealt a crushing defeat by a Hungarian force at Eisenach. Burchard, Duke of Thuringia, the duke of Thuringia, was killed. Thuringia was absorbed into Saxony.</td>
</tr>
<tr>
<td>910</td>
<td>12 June</td>
<td><em>Battle of Lechfeld (910):</em> A Hungarian force decisively defeated an East Frankish army near Augsburg after a feigned retreat.</td>
</tr>
<tr>
<td>911</td>
<td>20 September</td>
<td>Louis the Child died. The Lotharingian nobility, led by Reginar, Duke of Lorraine, elected Charles the Simple, king of France, to succeed him.</td>
</tr>
</tbody>
</table>
Conrad I the Younger of Germany, duke of Franconia, was elected king of East Francia by the rulers of the other East Frankish duchies, the so-called stem duchies of Bavaria, Saxony and Alamannia.

Berengar was crowned Holy Roman Emperor by the pope Pope John X.

Conrad died from injuries sustained in battle with Arnulf the Bad, Duke of Bavaria, the duke of Bavaria. He was succeeded as duke of Franconia by his younger brother Eberhard of Franconia.

Henry the Fowler, the duke of Saxony and Conrad's choice, was crowned king of Germany after his election by the dukes of the stem duchies.

King Charles the Simple of Lotharingia was captured in battle by French forces.

Berengar was murdered by a member of his retinue.

The Lotharingian nobility, led by Gilbert, Duke of Lorraine, elected Henry the Fowler their king.

Synod of Erfurt: A synod at Erfurt decided that Germany would cease paying tribute to Hungary.

Battle of Riade: A Hungarian force camped on the Unstrut was put to flight by a German army.

Henry died after a stroke. He was succeeded as duke of Saxony and king of Germany by his son Otto I the Great, Holy Roman Emperor.

Otto the Great created the Billung March, governed by Hermann Billung, and the Marca Geronis.

Rudolph II's son Conrad I of Burgundy became king of Burgundy with the support of Otto the Great against Hugh of Italy, the king of Italy.

Otto the Great deposed the duke of Bavaria Eberhard, Duke of Bavaria, installing his uncle Berthold, Duke of Bavaria on the condition that as king he retain the right to appoint bishops and administer royal property in Bavaria.

Battle of Andernach: A rebellion of Franconia and Lotharingia against Otto the Great was decisively defeated at Andernach. The dukes of Franconia and Lotharingia Eberhard of Franconia and Gilbert were killed. Otto the Great prevented succession in both duchies and dissolved the former.

Otto the Great appointed his younger brother Henry I, Duke of Bavaria duke of Lotharingia.

Battle of Lechfeld (955): Otto the Great repelled a Hungarian invasion on the flood plain of the Lech.

Battle on the Raxa: A German army defeated an Obotrite rebellion in the Billung March, probably on the Recknitz.
### 11th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1046</td>
<td>25 December</td>
<td>Clement II was elected pope.</td>
</tr>
<tr>
<td>1048</td>
<td>17 July</td>
<td>Damasus II was elected pope.</td>
</tr>
<tr>
<td>1049</td>
<td>12 February</td>
<td>Leo IX was elected pope.</td>
</tr>
<tr>
<td>1055</td>
<td>13 April</td>
<td>Victor II was elected pope.</td>
</tr>
<tr>
<td>1057</td>
<td>3 August</td>
<td>Stephen IX was elected pope.</td>
</tr>
<tr>
<td>1072</td>
<td></td>
<td>Agnes of Germany was born.</td>
</tr>
<tr>
<td>1075</td>
<td>28 February</td>
<td><em>Investiture controversy:</em> A council held at the Lateran Palace concluded that popes alone could appoint, remove and transfer bishops.</td>
</tr>
<tr>
<td>1077</td>
<td>28 January</td>
<td><em>Walk to Canossa:</em> After fasting outdoors in a blizzard for three days, Holy Roman</td>
</tr>
</tbody>
</table>
Emperor Henry IV was allowed to enter Canossa Castle and receive forgiveness from Pope Gregory VII for the illegitimate appointment of bishops.

1095
27 November
First Crusade: Pope Urban II called on all Catholics to assist the Byzantine Emperor Alexios I Komnenos in repelling the invading Seljuk Empire.

1096
Rhineland massacres: Crusaders took part in anti-Jewish violence in the Rhineland.

1098
Hildegard of Bingen was born.

12th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1122</td>
<td>23 September</td>
<td>Investiture Controversy: Pope Callixtus II and Holy Roman Emperor Henry V signed the Concordat of Worms, under which it was agreed that Holy Roman Emperors had the right to grant bishops secular authority but not religious authority.</td>
</tr>
<tr>
<td>1143</td>
<td>24 September</td>
<td>Agnes died.</td>
</tr>
<tr>
<td>1147</td>
<td></td>
<td>Northern Crusades: A series of crusades began against the pagan peoples around the Baltic Sea.</td>
</tr>
<tr>
<td>1152</td>
<td>9 March</td>
<td>Frederick I Barbarossa was crowned Holy Roman Emperor.</td>
</tr>
<tr>
<td>1170</td>
<td></td>
<td>Walther von der Vogelweide was born.</td>
</tr>
<tr>
<td>1190</td>
<td></td>
<td>A field hospital was established at Acre which would become the nucleus of the Teutonic Order.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Nibelungenlied was written.</td>
</tr>
</tbody>
</table>

13th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1201</td>
<td></td>
<td>Valdemar II of Denmark occupied Hamburg.</td>
</tr>
<tr>
<td>1210</td>
<td></td>
<td>The Lübeck Cathedral was constructed.</td>
</tr>
<tr>
<td>1214</td>
<td>27 July</td>
<td>Battle of Bouvines: The combined forces of Flanders, England, Boulogne and the Holy Roman Empire were dealt a decisive defeat by the French at Bouvines.</td>
</tr>
<tr>
<td>1230</td>
<td></td>
<td>St. Nicholas' Church was constructed in Berlin.</td>
</tr>
<tr>
<td>1241</td>
<td></td>
<td>Lübeck and Hamburg formed an alliance.</td>
</tr>
<tr>
<td>1244</td>
<td></td>
<td>Freie Stadt Mainz was founded in Mainz.</td>
</tr>
</tbody>
</table>
### 12th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1248</td>
<td></td>
<td>A Fire started in Hamburg.</td>
</tr>
<tr>
<td>1273</td>
<td>29 September</td>
<td>Rudolph I was crowned King of the Romans.</td>
</tr>
<tr>
<td>1290</td>
<td></td>
<td>Duchy of Cleves captured Duisburg.</td>
</tr>
<tr>
<td>1291</td>
<td>August</td>
<td>Crusades: The Crusades ended.</td>
</tr>
<tr>
<td>1298</td>
<td></td>
<td>St. Lawrence church was constructed.</td>
</tr>
</tbody>
</table>

### 14th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1338</td>
<td></td>
<td>The prince-electors of the Holy Roman Empire declared in the Declaration of Rhense that the election of the Holy Roman Emperor was not subject to the approval of the pope.</td>
</tr>
<tr>
<td>1356</td>
<td></td>
<td>The Imperial Diet issued the Golden Bull of 1356, which fixed the offices of the seven prince-electors and established that the Holy Roman Emperor could be elected by a simple majority vote.</td>
</tr>
<tr>
<td>1370</td>
<td></td>
<td>The Hanseatic League was established.</td>
</tr>
<tr>
<td>1392</td>
<td></td>
<td>The Treaty of Stralsund was signed, ending a war between Denmark and the Hanseatic League.</td>
</tr>
<tr>
<td>1400</td>
<td></td>
<td>The period of Meistersinger lyric poets began.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The period of Minnesänger singers ended.</td>
</tr>
</tbody>
</table>

### 15th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1410</td>
<td>15 July</td>
<td>Battle of Grunwald: The Teutonic Order was decisively defeated by the combined forces of Poland and Lithuania at Grunwald.</td>
</tr>
<tr>
<td>1414</td>
<td></td>
<td>Council of Constance: An ecumenical council began which would condemn Jan Hus as a heretic, depose Antipopes John XXIII and Benedict XIII, and elect Pope Martin V.</td>
</tr>
<tr>
<td>1418</td>
<td></td>
<td>Council of Constance: The council ended.</td>
</tr>
<tr>
<td>1455</td>
<td></td>
<td>The Gutenberg Bible, one of the first books in the West made using moveable type, was first printed by Johann Gutenberg.</td>
</tr>
<tr>
<td>1471</td>
<td>21 May</td>
<td>Albrecht Dürer was born.</td>
</tr>
<tr>
<td>1483</td>
<td>10 November</td>
<td>Martin Luther was born.</td>
</tr>
</tbody>
</table>
The Imperial Diet established the *Reichskammergericht*, a permanent court of appeal with jurisdiction over the whole of the Holy Roman Empire.

**Swabian War**: A war between the Old Swiss Confederacy and the House of Habsburg took place in which the Swiss would win an exemption from paying taxes to the Holy Roman Empire and participating in the Imperial Diet.

### 16th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1517</td>
<td>31 October</td>
<td>Luther posted the Ninety-Five Theses, a disputation condemning abuses in the Catholic Church, on the door of All Saint's Church in Wittenberg.</td>
</tr>
<tr>
<td>1521</td>
<td></td>
<td><em>Diet of Worms</em>: An Imperial Diet was held at Worms which would condemn Luther as a heretic.</td>
</tr>
<tr>
<td>1522</td>
<td>9 January</td>
<td>Adrian VI became pope.</td>
</tr>
<tr>
<td>1524</td>
<td></td>
<td><em>German Peasants' War</em>: An uprising of German-speaking peasants began.</td>
</tr>
<tr>
<td>1525</td>
<td></td>
<td><em>German Peasants' War</em>: The war ended in the defeat of the peasant army.</td>
</tr>
<tr>
<td></td>
<td>10 April</td>
<td><em>Prussian Homage</em>: Grand Master Albert of the Teutonic Order resigned his position and was appointed duke of Prussia by the Polish king Sigismund I the Old.</td>
</tr>
<tr>
<td>1529</td>
<td>19 April</td>
<td><em>Protestation at Speyer</em>: Six fürsten and the representatives of fourteen free imperial cities read out their objection to the imperial ban on Luther and his works at the Imperial Diet at Speyer.</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Siege of Vienna</em>: The Ottoman Empire was forced to retreat after the failure of their siege of Vienna.</td>
</tr>
<tr>
<td>1546</td>
<td>10 July</td>
<td><em>Schmalkaldic War</em>: A war began between the Schmalkaldic League of Lutheran principalities and a coalition led by the Holy Roman Empire.</td>
</tr>
<tr>
<td>1547</td>
<td>23 May</td>
<td><em>Schmalkaldic War</em>: The war ended in an imperial victory.</td>
</tr>
<tr>
<td>1554</td>
<td></td>
<td>Moritzbastei was constructed as a bastion.</td>
</tr>
<tr>
<td>1555</td>
<td>25 September</td>
<td>The Peace of Augsburg was signed, granting princes of the Holy Roman Empire the right to determine the state religion within their territories.</td>
</tr>
<tr>
<td>1583</td>
<td></td>
<td>Beginning of the Cologne War.</td>
</tr>
<tr>
<td>1588</td>
<td></td>
<td>End of the Cologne War.</td>
</tr>
<tr>
<td>1600</td>
<td></td>
<td>The period of <em>Meistersinger</em> lyric poets ended.</td>
</tr>
</tbody>
</table>

### 17th century
<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1608</td>
<td>14 May</td>
<td>The Protestant Union, a military alliance of Protestant German princes, was established under the command of Elector Frederick IV of the Palatinate.</td>
</tr>
<tr>
<td>1609</td>
<td>10 July</td>
<td>The Catholic League, an alliance of Catholic German princes, was established.</td>
</tr>
<tr>
<td>1613</td>
<td></td>
<td>King James I of England, Ireland and Scotland married his daughter Elizabeth Stuart to Elector Frederick V of the Palatinate, leader of the Protestant Union.</td>
</tr>
<tr>
<td>1618</td>
<td></td>
<td><em>Thirty Years' War:</em> A war began which would cause massive devastation and loss of life, primarily in Germany.</td>
</tr>
<tr>
<td>1629</td>
<td>6 March</td>
<td>Holy Roman Emperor Ferdinand II issued the Edict of Restitution, which demanded that lands expropriated since and in contradiction to the terms of the Peace of Augsburg be restored to the Catholic Church.</td>
</tr>
<tr>
<td>1631</td>
<td>20 May</td>
<td><em>Sack of Magdeburg:</em> Forces under the command of the Holy Roman Empire and the Catholic League breached the walls of the Protestant city of Magdeburg and murdered some twenty thousand of its thirty thousand inhabitants.</td>
</tr>
<tr>
<td></td>
<td>17 September</td>
<td><em>Battle of Breitenfeld:</em> The combined forces of Saxony and the Swedish Empire dealt a decisive defeat to the Holy Roman Empire and its allies near Breitenfeld.</td>
</tr>
<tr>
<td>1632</td>
<td>16 November</td>
<td><em>Battle of Lützen:</em> Forces led by the Swedish Empire defeated forces under the command of the Holy Roman Empire near Lützen. The Swedish king Gustavus Adolphus was killed.</td>
</tr>
<tr>
<td>1642</td>
<td>23 October</td>
<td><em>Battle of Breitenfeld:</em> The Swedish army dealt a decisive defeat to the Holy Roman Empire near Breitenfeld.</td>
</tr>
<tr>
<td>1648</td>
<td></td>
<td><em>Thirty Years' War:</em> The Peace of Westphalia was concluded, ending the war and granting Switzerland and the Netherlands independence from the Holy Roman Empire.</td>
</tr>
<tr>
<td>1683</td>
<td>11 September</td>
<td><em>Battle of Vienna:</em> The combined forces of the Polish–Lithuanian Commonwealth and the Holy Roman Empire and their allies broke an Ottoman siege of Vienna.</td>
</tr>
<tr>
<td>1686</td>
<td></td>
<td>The League of Augsburg, a military alliance of European countries, was established to defend the Palatinate from France.</td>
</tr>
<tr>
<td>1697</td>
<td>15 September</td>
<td>The elector of Saxony was elected King Augustus II the Strong of the Polish–Lithuanian Commonwealth.</td>
</tr>
<tr>
<td>1700</td>
<td>17 July</td>
<td>Leibniz founded the Prussian Academy of Sciences.</td>
</tr>
</tbody>
</table>

**18th century**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1701</td>
<td>18 January</td>
<td>Frederick I of Prussia crowned himself king; the Duchy of Prussia became the Kingdom of Prussia.</td>
</tr>
<tr>
<td>Year</td>
<td>Month</td>
<td>Event</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>1706</td>
<td></td>
<td>Pachelbel died.</td>
</tr>
<tr>
<td>1712</td>
<td>January</td>
<td>Frederick II of Prussia, the Great, was born.</td>
</tr>
<tr>
<td>1716</td>
<td>November</td>
<td>Leibniz died.</td>
</tr>
<tr>
<td>1740</td>
<td>December</td>
<td>The Prussian king Frederick the Great issued an ultimatum to Austria demanding the cession of Silesia according to the terms of an inheritance treaty.</td>
</tr>
<tr>
<td>1742</td>
<td>July</td>
<td>Silesian Wars: The Treaty of Berlin was signed, transferring most of Austria's Silesian territories to Prussia and ending the war.</td>
</tr>
<tr>
<td>1745</td>
<td>June</td>
<td>Battle of Hohenfriedberg: A Prussian force led by Frederick the Great decisively defeated the allied armies of Austria and Saxony, halting the attempted reconquest of Silesia.</td>
</tr>
<tr>
<td>1750</td>
<td>July</td>
<td>Bach died.</td>
</tr>
<tr>
<td>1763</td>
<td>February</td>
<td>Third Silesian War: Prussia, Austria and Saxony signed the Treaty of Hubertusburg, ending the war and restoring the three states' prewar borders.</td>
</tr>
<tr>
<td>1786</td>
<td>August</td>
<td>Frederick the Great died.</td>
</tr>
<tr>
<td>1788</td>
<td></td>
<td>The Abitur, a university admission exam, was established in Prussia.</td>
</tr>
<tr>
<td>1789</td>
<td>June</td>
<td>French Revolution: The Third Estate of the French Estates General declared itself the National Assembly.</td>
</tr>
<tr>
<td>1791</td>
<td>August</td>
<td>Prussia and the Holy Roman Empire issued the Declaration of Pillnitz, promising to join a coalition to restore Louis XVI of France to the French throne.</td>
</tr>
<tr>
<td>1792</td>
<td>April</td>
<td>French Revolutionary Wars: France declared war on Austria.</td>
</tr>
<tr>
<td>1796</td>
<td>May</td>
<td>Rhine Campaign of 1796: Austria declared that its truce with French forces in the area of the Rhine was over effective 31 May.</td>
</tr>
<tr>
<td>16 November</td>
<td>Frederick William III of Prussia became king of Prussia.</td>
<td></td>
</tr>
</tbody>
</table>
1799 9 November  *Coup of 18 Brumaire*: Three of the five members of the French Directory were persuaded to resign, the other two arrested.

19th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1802</td>
<td>25 March</td>
<td>French Revolutionary Wars: France and the United Kingdom signed the Treaty of Amiens, ending the war.</td>
</tr>
<tr>
<td>1803</td>
<td>27 April</td>
<td>Francis II, emperor of the Holy Roman Empire, ratified the <em>Reichsdeputationshauptschluss</em>, consolidating the states of the Empire especially through the secularization of ecclesiastical lands and abolishment of free imperial cities.</td>
</tr>
<tr>
<td>1804</td>
<td>12 February</td>
<td>Kant died.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Schiller published <em>William Tell</em>.</td>
</tr>
<tr>
<td>1805</td>
<td>9 May</td>
<td>Napoleonic Wars: Austria joined Britain, Sweden and Russia in the War of the Third Coalition against France.</td>
</tr>
<tr>
<td>1806</td>
<td>12 July</td>
<td>Sixteen German states established the Confederation of the Rhine, a confederation and protectorate of France.</td>
</tr>
<tr>
<td></td>
<td>6 August</td>
<td><em>Dissolution of the Holy Roman Empire</em>: Francis II, Holy Roman Emperor, emperor of the Holy Roman Empire, abdicated his title and released his subjects from their obligations to the empire.</td>
</tr>
<tr>
<td></td>
<td>14 October</td>
<td><em>Battle of Jena-Auerstedt</em>: French forces dealt a decisive defeat to a numerically superior Prussian army at Jena and Auerstedt.</td>
</tr>
<tr>
<td>1807</td>
<td></td>
<td>The Prussian minister Heinrich Friedrich Karl vom und zum Stein published the Nassauer Denkschrift, laying out his vision for the Prussian reforms.</td>
</tr>
<tr>
<td>1808</td>
<td>9 July</td>
<td>France and Prussia signed the second of the Treaties of Tilsit, in which the latter ceded half of its territory to Russia and French client states.</td>
</tr>
<tr>
<td>1808</td>
<td></td>
<td>Johann Gottlieb Fichte published his <em>Addresses to the German Nation</em>, arguing for German nationalism and unity.</td>
</tr>
<tr>
<td>1810</td>
<td></td>
<td>Robert Schumann was born.</td>
</tr>
<tr>
<td>1812</td>
<td></td>
<td>The Brothers Grimm published their first collection of fairy tales.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>1813</td>
<td>22 May Richard Wagner was born.</td>
<td></td>
</tr>
<tr>
<td>19 October</td>
<td>Battle of Leipzig: The French army was encircled and forced to retreat from Leipzig in a battle in which some ninety thousand French and allied troops were killed or injured.</td>
<td></td>
</tr>
<tr>
<td>1814</td>
<td>30 May War of the Sixth Coalition: France signed the Treaty of Paris, under which it returned to its 1792 borders and the House of Bourbon was restored to the French throne, ending the war.</td>
<td></td>
</tr>
<tr>
<td>1815</td>
<td>1 April Otto von Bismarck was born.</td>
<td></td>
</tr>
<tr>
<td>9 June</td>
<td>Congress of Vienna: A conference of twenty-three ambassadors signed a treaty reordering Europe's national boundaries and establishing freedom of navigation on the Rhine and the Danube. France was greatly expanded and a German Confederation of thirty-four states was established.</td>
<td></td>
</tr>
<tr>
<td>18 June</td>
<td>Battle of Waterloo: The restored French emperor Napoleon was dealt a decisive defeat by the United Kingdom and its allies at Waterloo.</td>
<td></td>
</tr>
<tr>
<td>31 October</td>
<td>Karl Weierstrass was born.</td>
<td></td>
</tr>
<tr>
<td>1816</td>
<td>5 May The constitution of the Grand Duchy of Saxe-Weimar-Eisenach was promulgated.</td>
<td></td>
</tr>
<tr>
<td>1817</td>
<td>18 October Wartburg Festival: A protest of liberal students took place at Wartburg.</td>
<td></td>
</tr>
<tr>
<td>1818</td>
<td>5 May Karl Marx was born.</td>
<td></td>
</tr>
<tr>
<td>26 May</td>
<td>The Bavarian king Maximilian I Joseph of Bavaria issued a constitution which established a bicameral legislature, the Landtag of Bavaria, and guaranteed freedom of religion.</td>
<td></td>
</tr>
<tr>
<td>22 August</td>
<td>The legislature of the Grand Duchy of Baden held its first meeting.</td>
<td></td>
</tr>
<tr>
<td>1819</td>
<td>18 March The conservative writer August von Kotzebue was fatally stabbed by a liberal theology student, Karl Ludwig Sand.</td>
<td></td>
</tr>
<tr>
<td>20 September</td>
<td>Representatives of the states of the German Confederation issued the Carlsbad Decrees, under which each resolved to become involved in instruction and hiring at universities, require prior restraint on all serial publications, and dissolve student organizations such as the liberal Burschenschaften.</td>
<td></td>
</tr>
<tr>
<td>1826</td>
<td>17 September Bernhard Riemann was born.</td>
<td></td>
</tr>
<tr>
<td>1827</td>
<td>26 March Beethoven died.</td>
<td></td>
</tr>
<tr>
<td>1828</td>
<td>19 November Schubert died.</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Month</td>
<td>Event</td>
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<td>------</td>
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</tr>
<tr>
<td>1830</td>
<td>September</td>
<td>Charles II, Duke of Brunswick was forced by an angry mob to flee the capital Braunschweig.</td>
</tr>
<tr>
<td>1831</td>
<td>November</td>
<td>Hegel died.</td>
</tr>
<tr>
<td>1832</td>
<td>March</td>
<td>Goethe died.</td>
</tr>
<tr>
<td></td>
<td>April</td>
<td>Wilhelm Busch was born.</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td><em>Hambach Festival</em>: A rally began at Hambach Castle where participants demonstrated for the liberalization and unification of the German states.</td>
</tr>
<tr>
<td>1833</td>
<td>May</td>
<td>Johannes Brahms was born.</td>
</tr>
<tr>
<td>1834</td>
<td>January</td>
<td>The <em>Zollverein</em> came into existence, merging the Bavaria–Württemberg Customs Union, the Prussia–Hesse-Darmstadt Customs Union and the Thuringian Customs and Commerce Union into a single customs union.</td>
</tr>
<tr>
<td>1837</td>
<td></td>
<td>The Göttingen Seven published a document opposing the decision of Ernest Augustus, King of Hanover, to abrogate his country's 1833 constitution.</td>
</tr>
<tr>
<td>1839</td>
<td></td>
<td>Belgium, the Netherlands, the United Kingdom, Austria, France, Russia and the German Confederation signed the Treaty of London, recognizing Belgium's independence and guaranteeing its neutrality.</td>
</tr>
<tr>
<td>1840</td>
<td>June</td>
<td>Frederick William died.</td>
</tr>
<tr>
<td></td>
<td>June</td>
<td>The educator Friedrich Fröbel coined the term kindergarten.</td>
</tr>
<tr>
<td>1841</td>
<td></td>
<td>The economist Friedrich List published his National System of Political Economy.</td>
</tr>
<tr>
<td>1844</td>
<td>October</td>
<td>Friedrich Nietzsche was born.</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>Karl Benz was born</td>
</tr>
<tr>
<td>1848</td>
<td>February</td>
<td><em>German revolutions of 1848–49</em>: An assembly in Mannheim adopted a resolution demanding a bill of rights.</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td><em>First Schleswig War</em>: Ethnic German rebels loyal to the provisional government in the Danish duchies of Schleswig and Holstein captured the government fortress at Rendsburg.</td>
</tr>
<tr>
<td></td>
<td>May</td>
<td><em>German federal election, 1848</em>: Elections were held in the thirty-nine states of the German Confederation to a national constituent assembly, the Frankfurt Parliament.</td>
</tr>
<tr>
<td>1849</td>
<td>June</td>
<td><em>German revolutions of 1848–49</em>: The chamber of the Frankfurt Parliament, since reduced to a rump parliament and moved to Stuttgart, was occupied by the Württemberg army. A repression began which would force the liberal Forty-Eighters into exile.</td>
</tr>
<tr>
<td>1850</td>
<td>May</td>
<td>The Prussian three-class franchise, according to which all males over the age of 24 were allowed to vote for their representatives in the lower house of the Prussian parliament,</td>
</tr>
</tbody>
</table>
with votes weighted by amount of taxes paid, was introduced.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>29 November</td>
<td>Prussia and Austria signed the Punctuation of Olmütz, under which the former agreed to the dissolution of the Prussian-led Erfurt Union and the revival of the German Confederation under Austrian leadership.</td>
</tr>
<tr>
<td>1852</td>
<td><strong>8 May</strong> First Schleswig War: Austria, France, Prussia, Russia, Sweden, Denmark and the United Kingdom signed the London Protocol, guaranteeing the nominal independence of Schleswig and Holstein in personal union with Denmark and ending the war.</td>
</tr>
<tr>
<td>1855</td>
<td><strong>23 February</strong> Gauss died.</td>
</tr>
<tr>
<td>1856</td>
<td><strong>August</strong> Neanderthal remains were discovered in Neandertal.</td>
</tr>
<tr>
<td>1858</td>
<td><strong>23 April</strong> Max Planck was born.</td>
</tr>
<tr>
<td>1859</td>
<td>The reformist Albrecht von Roon was appointed Prussian minister of war.</td>
</tr>
<tr>
<td>1863</td>
<td><strong>23 May</strong> The General German Workers' Association was formed.</td>
</tr>
<tr>
<td>1864</td>
<td><strong>1 February</strong> Second Schleswig War: Prussia invaded Schleswig.</td>
</tr>
<tr>
<td></td>
<td><strong>30 October</strong> Second Schleswig War: Denmark, Austria and Prussia signed the Treaty of Vienna, placing the duchies of Schleswig and Holstein under Prussian and Austrian administration, respectively, and ending the war.</td>
</tr>
<tr>
<td>1866</td>
<td><strong>14 June</strong> Austro-Prussian War: Prussia declared war on Austria.</td>
</tr>
<tr>
<td></td>
<td><strong>3 July</strong> Battle of Königgrätz: Prussian forces broke an Austrian line and dealt them a decisive defeat at modern Hradec Králové.</td>
</tr>
<tr>
<td></td>
<td><strong>20 July</strong> Riemann died.</td>
</tr>
<tr>
<td>1870</td>
<td><strong>10 March</strong> Deutsche Bank was established.</td>
</tr>
<tr>
<td>1871</td>
<td><strong>18 January</strong> William was crowned emperor of the German Empire in the Hall of Mirrors at Versailles.</td>
</tr>
<tr>
<td></td>
<td><strong>21 March</strong> Minister President Otto von Bismarck of Prussia was appointed Chancellor of the German Empire.</td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
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<td>------</td>
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</tr>
<tr>
<td>1872</td>
<td>11 March</td>
</tr>
<tr>
<td>1873</td>
<td>22 October</td>
</tr>
<tr>
<td>1875</td>
<td>6 June</td>
</tr>
<tr>
<td>1878</td>
<td>13 July</td>
</tr>
<tr>
<td>1879</td>
<td>7 October</td>
</tr>
<tr>
<td>1880</td>
<td>July</td>
</tr>
<tr>
<td>1880</td>
<td>16 December</td>
</tr>
<tr>
<td>1882</td>
<td>20 May</td>
</tr>
<tr>
<td>1883</td>
<td>13 February</td>
</tr>
<tr>
<td>1883</td>
<td>14 March</td>
</tr>
<tr>
<td>1884</td>
<td>15 November</td>
</tr>
<tr>
<td>1886</td>
<td></td>
</tr>
<tr>
<td>1887</td>
<td>18 June</td>
</tr>
<tr>
<td>1889</td>
<td>20 April</td>
</tr>
<tr>
<td>1890</td>
<td>20 March</td>
</tr>
<tr>
<td>1890</td>
<td>1 July</td>
</tr>
<tr>
<td>1891</td>
<td></td>
</tr>
<tr>
<td>1892</td>
<td></td>
</tr>
</tbody>
</table>
1896 3 January  The German emperor Wilhelm II, German Emperor sent the Kruger telegram to president Paul Kruger of the South African Republic, congratulating him on the successful repulsion of the Jameson Raid.

1897 19 February  Weierstrass died.

3 April  Brahms died.

1898 30 July  Bismarck died.


1900 25 August  Nietzsche died.

20th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1905</td>
<td>31 March</td>
<td>First Moroccan Crisis: Wilhelm met with representatives of the Moroccan sultan Abdelaziz of Morocco in Tangier in support of Moroccan sovereignty.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Field marshal Alfred von Schlieffen, chief of the German General Staff, developed the Schlieffen Plan, a plan for the quick invasion and conquest of France through Belgium and the Netherlands in the event of a two-front war.</td>
</tr>
<tr>
<td>1906</td>
<td>7 April</td>
<td>Algeciras Conference: Germany, Austria-Hungary, the United Kingdom, France, Russia, Spain, the United States, Italy, Morocco, the Netherlands, Sweden, Portugal and Belgium signed the final act of the conference, which limited Moroccan spending and placed French and Spanish officers in charge of its police.</td>
</tr>
<tr>
<td>1908</td>
<td>9 January</td>
<td>Poet Wilhelm Busch died.</td>
</tr>
<tr>
<td>1911</td>
<td>1 July</td>
<td>Agadir Crisis: The German gunboat SMS Panther arrived at the Moroccan port of Agadir.</td>
</tr>
<tr>
<td>1913</td>
<td>6 November</td>
<td>Saverne Affair: Two local Saverne papers reported on offensive comments made by a local Prussian military officer.</td>
</tr>
<tr>
<td>1914</td>
<td></td>
<td>Albert Einstein moved to Berlin.</td>
</tr>
<tr>
<td>1914</td>
<td>28 July</td>
<td>World War I: Austria-Hungary declared war on Serbia.</td>
</tr>
<tr>
<td>1914</td>
<td>4 August</td>
<td>World War I: The United Kingdom declared war on Germany.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Blockade of Germany: The United Kingdom established a blockade of war materiel and foodstuffs bound for Germany.</td>
</tr>
<tr>
<td>1914</td>
<td>30 August</td>
<td>Battle of Tannenberg: The German 8th Army decisively defeated a Russian force near Olsztyn, practically destroying the Russian 2nd Army.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
<td>Description</td>
</tr>
<tr>
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<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>9 September</td>
<td>First Battle of the Marne:</td>
<td>French forces met the invading 1st and 2nd Armies of the German Empire at the Marne.</td>
</tr>
<tr>
<td>1915 22 April</td>
<td>Second Battle of Ypres:</td>
<td>The German army released chlorine gas against the French line at Ypres.</td>
</tr>
<tr>
<td>1916 31 May</td>
<td>Battle of Jutland:</td>
<td>The British Grand Fleet and the German High Seas Fleet met in battle in the North Sea, at a cost of some ten thousand lives and several ships sunk.</td>
</tr>
<tr>
<td>4 June</td>
<td>Brusilov Offensive:</td>
<td>The Russian Empire launched an offensive across the Eastern Front in the Austrian Kingdom of Galicia and Lodomeria which would cost some half million Russian casualties and over a million German and Austrian casualties.</td>
</tr>
<tr>
<td>1 July</td>
<td>Battle of the Somme:</td>
<td>A British force drove the German 2nd Army behind its first line of defense at a cost of some sixty thousand casualties.</td>
</tr>
<tr>
<td>24 October</td>
<td>Battle of Verdun:</td>
<td>The French Second Army consolidated control over Fort Douaumont in Douaumont, ending major operations in a battle which cost as many as one million French and German casualties.</td>
</tr>
<tr>
<td>1917 1 February</td>
<td>The Turnip Winter begins— a period of famine in which the German people were driven to subsist on turnips.</td>
<td>The Turnip Winter ends.</td>
</tr>
<tr>
<td>1917 1 February</td>
<td>The German navy introduced unrestricted submarine warfare,</td>
<td>in which submarines sought to destroy surface ships without warning.</td>
</tr>
<tr>
<td>1918 21 March</td>
<td>Spring Offensive:</td>
<td>German forces attacked the British Fifth Army and broke their line in northern France.</td>
</tr>
<tr>
<td>8 August</td>
<td>Hundred Days Offensive:</td>
<td>An allied force of primarily French, British and American troops drove back the German line at Amiens.</td>
</tr>
<tr>
<td>1917 9 November</td>
<td>German Revolution of 1918–19:</td>
<td>Wilhelm abdicated his titles as German Emperor and king of Prussia.</td>
</tr>
<tr>
<td>1917 10 November</td>
<td>German Revolution of 1918–19: The Council of the People's Deputies,</td>
<td>a body elected from the workers' councils of Berlin, introduced sweeping liberal reforms including the elimination of the Prussian three-class franchise and women's suffrage.</td>
</tr>
<tr>
<td>11 November</td>
<td>World War I: A German delegation signed the Armistice of 11 November</td>
<td>1918, promising an immediate cessation of hostilities, significant territorial concessions, and the surrender of Germany's war materiel.</td>
</tr>
<tr>
<td>1919 15 January</td>
<td>Spartacist uprising:</td>
<td>The Freikorps crushed a Berlin uprising by the Marxist Spartacus League, killing some hundred and fifty civilians and executing their leaders Karl Liebknecht and Rosa Luxemburg.</td>
</tr>
<tr>
<td>1919 11 February</td>
<td>German presidential election, 1919:</td>
<td>Friedrich Ebert of the Social Democratic Party of Germany (SPD) was elected president by the Weimar National Assembly, with seventy-three</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
<td>Description</td>
</tr>
<tr>
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</tr>
<tr>
<td>6 April</td>
<td>Ernst Toller declared the establishment of a Bavarian Council Republic in Bavaria.</td>
<td></td>
</tr>
<tr>
<td>28 June</td>
<td>Paris Peace Conference, 1919: Representatives of some thirty world powers signed the Treaty of Versailles, under which Germany was forced to disarm, give up its colonies, make substantial territorial concessions, and pay reparations to the Allies.</td>
<td></td>
</tr>
<tr>
<td>11 August</td>
<td>The Weimar Constitution came into force. The Weimar Republic succeeded the German Empire.</td>
<td></td>
</tr>
<tr>
<td>1920</td>
<td>1921</td>
<td>Ruhr uprising: The Communist Party of Germany, the Communist Workers' Party of Germany, the Independent Social Democratic Party of Germany and the Free Workers' Union of Germany together established the Ruhr Red Army, which expelled the Freikorps from the valley of the Ruhr.</td>
</tr>
<tr>
<td>1920</td>
<td>June</td>
<td>Hyperinflation in the Weimar Republic: Inflation of the Papiermark (Mark) began in response to the first reparations payment to the Allies under the terms of the Treaty of Versailles.</td>
</tr>
<tr>
<td>1922</td>
<td>16 April</td>
<td>Germany and Russia signed the Treaty of Rapallo, in which each renounced all territorial and financial claims against the other and pledged to normalize relations.</td>
</tr>
<tr>
<td>1923</td>
<td>11 January</td>
<td>Occupation of the Ruhr: France invaded the valley of the Ruhr.</td>
</tr>
<tr>
<td>1923</td>
<td>13 August</td>
<td>Gustav Stresemann of the national liberal German People's Party was appointed chancellor and minister for foreign affairs.</td>
</tr>
<tr>
<td>1923</td>
<td>8 November</td>
<td>Beer Hall Putsch: Nazi Party chairman Adolf Hitler led some six hundred Sturmabteilung (SA) to the Bürgerbräukeller in Munich, where they held Bavarian state officials Gustav Ritter von Kahr, Hans Ritter von Seisser and Otto von Lossow at gunpoint to demand they support a Nazi coup.</td>
</tr>
<tr>
<td>1924</td>
<td>August</td>
<td>Germany and the Triple Entente agreed to the Dawes Plan negotiated by head of the United States Bureau of the Budget chief Charles G. Dawes, under which the French and Belgian occupation of the Ruhr valley was ended and the reparation payment schedule restructured.</td>
</tr>
<tr>
<td>1925</td>
<td>16 October</td>
<td>The last of the Locarno Treaties, under which France, Belgium and Germany settled their borders and pledged not to attack each other, was signed.</td>
</tr>
<tr>
<td>1926</td>
<td>8 September</td>
<td>Germany joined the League of Nations.</td>
</tr>
<tr>
<td>1929</td>
<td>31 August</td>
<td>The Allies accepted the Young Plan, which reduced Germany's war reparations and allowed it to defer a greater portion, which would accrue interest due to a consortium of American banks.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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<td></td>
</tr>
<tr>
<td>3 October</td>
<td>Stresemann died.</td>
<td></td>
</tr>
<tr>
<td>29 October</td>
<td>Wall Street Crash of 1929: The Dow Jones Industrial Average dropped twelve percent in a trading session of record volume.</td>
<td></td>
</tr>
<tr>
<td>1930</td>
<td>14 September  German federal election, 1930: The SPD retained a plurality of seats in the Reichstag. The Nazi Party gained ninety-five seats.</td>
<td></td>
</tr>
<tr>
<td>1933</td>
<td>30 January  Hitler was appointed chancellor at the head of a Nazi-DNVP coalition. The process of Gleichschaltung, in which the government dismantled non-Nazi parties and societies, began.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>27 February  Reichstag fire: The Reichstag building was burned. The Dutch council communist Marinus van der Lubbe was caught at the scene and confessed.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>28 February  President Paul von Hindenburg issued the Reichstag Fire Decree, suspending most civil liberties.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24 March    The Enabling Act of 1933, which granted the cabinet the power to make laws, was passed and signed in the presence of armed members of the SA and Schutzstaffel (SS).</td>
<td></td>
</tr>
<tr>
<td></td>
<td>20 July     Vice-chancellor Franz von Papen of Germany and cardinal secretary of state Pope Pius XII of the Holy See signed the Reichskonkordat, which required bishops to swear loyalty to the president of Germany.</td>
<td></td>
</tr>
<tr>
<td>1934</td>
<td>30 June     Night of the Long Knives: SS paramilitaries killed at least eighty-five potential threats to Hitler's power, including SA head Ernst Röhm and Gregor Strasser, head of the left wing of the Nazi Party.</td>
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<td></td>
<td>1 August    Hitler issued a law merging the powers of the presidency into the office of the chancellor.</td>
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<td></td>
<td>2 August    Hindenburg died from lung cancer.</td>
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<tr>
<td>1935</td>
<td>16 March    German re-armament: Hitler announced that Germany would rebuild its military, in violation of the Treaty of Versailles.</td>
<td></td>
</tr>
<tr>
<td>1936</td>
<td>7 March     Remilitarisation of the Rhineland: German troops entered the Rhineland in violation of the Treaty of Versailles. 1936 Summer Olympics: Germany won the greatest number of gold, silver and bronze medals at the Olympics, held in Berlin. Black American Jesse Owens won four gold medals, the highest individual total.</td>
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<tr>
<td>1938</td>
<td>12 March    Anschluss: German troops entered Austria.</td>
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<td></td>
<td>9 November  Kristallnacht: A pogrom took place in which SA paramilitaries and German civilians destroyed Jewish businesses and at least ninety-one were killed.</td>
<td></td>
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<tr>
<td>1939</td>
<td>23 August   The Molotov–Ribbentrop Pact was signed, promising mutual non-aggression between Germany and the Soviet Union and agreeing to a division of much of Eastern Europe between those two countries.</td>
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<tr>
<td></td>
<td>1 Invasion of Poland: Germany invaded Poland.</td>
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<td>Date</td>
<td>Event</td>
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<tr>
<td>September</td>
<td>Konrad Zuse built the Z3.</td>
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<tr>
<td>1942</td>
<td>20 January Wannsee Conference: A government conference was held to</td>
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<td></td>
<td>discuss the implementation of the Final Solution, the extermination</td>
<td></td>
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<tr>
<td></td>
<td>of European Jewry.</td>
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<tr>
<td>1945</td>
<td>30 April Death of Adolf Hitler: Hitler committed suicide by gunshot</td>
<td></td>
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<tr>
<td></td>
<td>in the Führerbunker in Berlin.</td>
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<tr>
<td></td>
<td>26 June The Christian Democratic Union of Germany (CDU) was founded.</td>
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<tr>
<td></td>
<td>1 August Potsdam Conference: British prime minister Clement Attlee,</td>
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<td></td>
<td>president Harry S. Truman of the United States and Joseph Stalin,</td>
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<tr>
<td></td>
<td>the general secretary of the Soviet Communist Party, issued the</td>
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<tr>
<td></td>
<td>Potsdam Agreement at Cecilienhof in Potsdam. The parties agreed that</td>
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<tr>
<td></td>
<td>Germany would be returned to its 1937 borders with some additional</td>
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<tr>
<td></td>
<td>cessions to the Soviet Union and ratified its division into British,</td>
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<tr>
<td></td>
<td>French, American and Soviet occupation zones.</td>
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<tr>
<td>1946</td>
<td>29 March The first of the Allied plans for German industry after</td>
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<td></td>
<td>World War II, which called for the reduction of German industrial</td>
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<td></td>
<td>capacity, was issued by the Allied Control Council.</td>
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<tr>
<td></td>
<td>6 September United States secretary of state James F. Byrnes read the</td>
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<td></td>
<td>speech Restatement of Policy on Germany, clarifying his nation's</td>
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<tr>
<td></td>
<td>desire for economic recovery in Germany and guaranteeing its borders.</td>
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<tr>
<td>1947</td>
<td>4 October Planck died.</td>
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<tr>
<td>1948</td>
<td>20 June Ludwig Erhard, the appointed economic director of the Bizone,</td>
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<tr>
<td></td>
<td>introduced the Deutsche Mark.</td>
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<tr>
<td></td>
<td>24 June Berlin Blockade: The Soviet Union blocked Western Bloc access</td>
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<tr>
<td></td>
<td>to West Berlin by road and rail.</td>
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<tr>
<td></td>
<td>25 June Berlin Blockade: United States cargo planes began shipping</td>
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<td></td>
<td>food and medical supplies to West Berlin.</td>
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<tr>
<td></td>
<td>12 December The Free Democratic Party (FDP) was established.</td>
<td></td>
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<tr>
<td>1949</td>
<td>12 May Berlin Blockade: The Soviet Union lifted the blockade.</td>
<td></td>
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<tr>
<td></td>
<td>23 May West Germany was founded.</td>
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<tr>
<td></td>
<td>14 August West German federal election, 1949: The CDU and Christian</td>
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<tr>
<td></td>
<td>Social Union in Bavaria (CSU) won a narrow plurality of seats in the</td>
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<tr>
<td></td>
<td>Bundestag.</td>
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<tr>
<td></td>
<td>15 September Konrad Adenauer of the CDU became chancellor of West</td>
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<tr>
<td></td>
<td>Germany.</td>
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<tr>
<td></td>
<td>7 October East Germany was founded.</td>
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<tr>
<td>1950</td>
<td>Wirtschaftswunder: The Times first used the term Wirtschaftswunder to</td>
<td></td>
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<tr>
<td></td>
<td>refer to the rapid postwar economic growth of West Germany and Austria.</td>
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<tr>
<td>1951</td>
<td>18 April The Inner Six European nations including West Germany signed</td>
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<tr>
<td></td>
<td>the Treaty of Paris establishing the European Coal and Steel</td>
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<td></td>
<td>Community, a single market in coal and steel governed by</td>
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<tr>
<td></td>
<td>supranational institutions.</td>
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<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
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<tr>
<td>1952</td>
<td>26 May</td>
<td>East Germany strengthened its border protection regime along the Inner German border.</td>
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<tr>
<td></td>
<td></td>
<td>The General Treaty, which granted West Germany the &quot;authority of a sovereign state&quot;, was signed by West Germany, France, the United States and the United Kingdom.</td>
</tr>
<tr>
<td>1953</td>
<td>16 June</td>
<td><strong>Uprising of 1953 in East Germany:</strong> In response to a 10 percent increase in work quotas, between 60 and 80 construction workers went on strike in East Berlin. Their numbers quickly swelled and a general strike and protests were called for the next day.</td>
</tr>
<tr>
<td></td>
<td>17 June</td>
<td><strong>Uprising of 1953 in East Germany:</strong> 100,000 protestors gathered at dawn, demanding the reinstatement of old work quotas and, later, the resignation of the East German government. At noon German police trapped many of the demonstrators in an open square; Soviet tanks fired on the crowd, killing hundreds and ending the protest.</td>
</tr>
<tr>
<td>1954</td>
<td>4 July</td>
<td><strong>1954 FIFA World Cup Final:</strong> West Germany defeated the heavily favored Hungarian national team in the final match of the FIFA World Cup in Bern.</td>
</tr>
<tr>
<td>1955</td>
<td>9 May</td>
<td>West Germany joined the North Atlantic Treaty Organization (NATO), a collective defense organization.</td>
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<tr>
<td></td>
<td>14 May</td>
<td>Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, Romania and the Soviet Union established the Warsaw Pact, a collective defense organization.</td>
</tr>
<tr>
<td></td>
<td>12 August</td>
<td>Mann died.</td>
</tr>
<tr>
<td>1961</td>
<td>13 August</td>
<td>Construction began on the Berlin Wall between East and West Berlin.</td>
</tr>
<tr>
<td>1963</td>
<td>16 October</td>
<td>Erhard became chancellor of West Germany.</td>
</tr>
<tr>
<td>1964</td>
<td>November</td>
<td>The National Democratic Party of Germany (NPD) was established.</td>
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<tr>
<td>1966</td>
<td>1 December</td>
<td>Erhard resigned.</td>
</tr>
<tr>
<td></td>
<td>1 December</td>
<td>Kurt Georg Kiesinger of the CDU was elected Chancellor of West Germany in coalition with the SPD.</td>
</tr>
<tr>
<td>1967</td>
<td>2 June</td>
<td>The unarmed student Benno Ohnesorg, a member of the German student movement, was shot and killed by Karl-Heinz Kurras, a Berlin Police inspector and East German spy, while protesting the state visit of shah Mohammad Reza Pahlavi of Iran.</td>
</tr>
<tr>
<td>1968</td>
<td>30 May</td>
<td>The German Emergency Acts were passed, amending the Basic Law for the Federal Republic of Germany to allow for the restriction of certain freedoms in the event of an emergency, and marking a major political defeat for the German student movement.</td>
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<tr>
<td>1969</td>
<td>21 October</td>
<td>Willy Brandt of the SPD was elected chancellor of West Germany.</td>
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<tr>
<td>1970</td>
<td>5 June</td>
<td>The Marxist–Leninist terrorist group the Red Army Faction (RAF) was founded.</td>
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<td></td>
<td>19 June</td>
<td>The voting age for participation in West German federal elections was lowered from twenty-one to eighteen.</td>
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<tr>
<td></td>
<td>12 August</td>
<td>West Germany and the Soviet Union signed the Treaty of Moscow, in which the former</td>
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<tr>
<td>Date</td>
<td>Event</td>
<td>Details</td>
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<tr>
<td>7 December</td>
<td>West Germany and Poland signed the Treaty of Warsaw, in which both parties pledged to remain at peace and the former again affirmed its recognition of the border at the Oder–Neisse line.</td>
<td></td>
</tr>
<tr>
<td>1971</td>
<td>France, the United Kingdom, the United States and the Soviet Union signed the Four Power Agreement on Berlin, in which all parties pledged peace and the latter pledged to continue to allow trade and communication between West Berlin and West Germany.</td>
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<tr>
<td>1972</td>
<td>26 August 1972 Summer Olympics: The Olympic games opened in Munich, in West Germany.</td>
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<tr>
<td>1972</td>
<td>5 September Munich massacre: Eight members of the Black September Organization snuck into the Olympic Village in Munich and took nine members of the Israeli team hostage.</td>
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<tr>
<td>1972</td>
<td>21 December East and West Germany signed the Basic Treaty, in which each recognized the other's sovereignty.</td>
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<tr>
<td>1973</td>
<td>18 September East and West Germany were admitted to the United Nations (UN).</td>
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<tr>
<td>1974</td>
<td>16 May Helmut Schmidt of the SPD was elected chancellor of West Germany.</td>
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<tr>
<td>1974</td>
<td>7 July 1974 FIFA World Cup Final: West Germany beat the Netherlands national team in the final match of the FIFA World Cup in Munich, in West Germany.</td>
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<tr>
<td>1982</td>
<td>Germany wins the Eurovision Song Contest 1982, marking their first win by Nicole with 'Ein Bißchen Frieden'</td>
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<tr>
<td>1987</td>
<td>1 October Helmut Kohl of the CDU became chancellor of West Germany.</td>
<td></td>
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<tr>
<td>1989</td>
<td>4 September Monday demonstrations in East Germany: A peaceful demonstration began in Leipzig, in East Germany, which called for democracy and the right of citizens to travel abroad.</td>
<td></td>
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<tr>
<td>1990</td>
<td>8 July 1990 FIFA World Cup Final: West Germany beat the Argentine national team in the final match of the FIFA World Cup in Rome.</td>
<td></td>
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<tr>
<td>1992</td>
<td>7 February The Maastricht Treaty establishing the European Union (EU) was signed by twelve European countries including Germany.</td>
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<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
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<tr>
<td>1993</td>
<td>14 May</td>
<td>Alliance '90/The Greens was established from the merger of Alliance 90 and the Green Party.</td>
</tr>
<tr>
<td>1994</td>
<td>20 April</td>
<td>The Federal Constitutional Court held that the Bundeswehr could take part in UN peacekeeping operations outside NATO territory.</td>
</tr>
<tr>
<td>1998</td>
<td>20 April</td>
<td>Gerhard Schröder of the SPD became chancellor at the head of a coalition with Alliance '90/The Greens.</td>
</tr>
<tr>
<td>1998</td>
<td>24 March</td>
<td>NATO bombing of Yugoslavia: NATO forces began bombing the Federal Republic of Yugoslavia in support of the Kosovo Liberation Army.</td>
</tr>
<tr>
<td>1999</td>
<td>1 June</td>
<td>Expo 2000: A world's fair was held in Hanover.</td>
</tr>
</tbody>
</table>

21st century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>1 January</td>
<td>Physical Euro currency was introduced. The Deutsche Mark lost its status as legal tender in Germany.</td>
</tr>
<tr>
<td>2005</td>
<td>19 April</td>
<td>Pope Benedict XVI was elected pope.</td>
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<tr>
<td>2005</td>
<td>22 November</td>
<td>Angela Merkel of the CDU became chancellor in coalition with the CSU and SPD.</td>
</tr>
<tr>
<td>2006</td>
<td>19 April</td>
<td>2006 FIFA World Cup: The 2006 FIFA World Cup was held in Germany.</td>
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<tr>
<td>2009</td>
<td>27 September</td>
<td>German federal election, 2009: Elections were held to the Bundestag. The SPD lost seventy-six seats; the CDU-CSU coalition and the liberal Free Democratic Party of Germany (FDP) gained.</td>
</tr>
<tr>
<td>2010</td>
<td>23 April</td>
<td>European debt crisis: Greece requested a loan from the EU and the International Monetary Fund.</td>
</tr>
<tr>
<td>2010</td>
<td>29 May</td>
<td>Germany wins the Eurovision Song Contest 2010, with Lena and 'Satellite'. This was their second win.</td>
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<tr>
<td>2012</td>
<td>18 March</td>
<td>Joachim Gauck was elected Federal President.</td>
</tr>
<tr>
<td>2013</td>
<td>22 September</td>
<td>German federal election, 2013: Elections were held to the Bundestag. The FDP failed to meet the electoral threshold. The CDU-CSU coalition and the SPD both gained seats.</td>
</tr>
<tr>
<td>2014</td>
<td>17 March</td>
<td>The EU instituted travel bans and asset freezes against individuals connected with the Russian invasion of Crimea.</td>
</tr>
<tr>
<td>2014</td>
<td>13 July</td>
<td>2014 FIFA World Cup Final: Germany defeated the Argentine national team in the final match of the FIFA World Cup in extra time in Rio de Janeiro.</td>
</tr>
<tr>
<td>2015</td>
<td>1 June</td>
<td>In European migrant crisis migrants number in Germany increase up to 1.5 million in</td>
</tr>
</tbody>
</table>
## Timeline of Native American art history

### Before common era

- 33,950–15,050 BCE: Artists paint hundreds of images at Serra da Capivara, Piauí, in northeastern Brazil.
- 12,800–8,500 BCE: Artists etch the Winnemucca Lake petroglyphs, near Reno, Nevada.
- 11,000 BCE: Megafauna bone etched with a profile image of a walking mammoth and cross-hatched designs left near Vero Beach, Florida is the oldest known portable art in the Americas.
- 10,000–7000 BCE: "Horny Little Man," a petroglyph depicting a stick figure with an oversized phallus, is carved in Lapa do Santo, a cave in central-eastern Brazil, is the oldest reliably dated rock art in the Americas.
- 9250–8950 BCE: Clovis points - thin, fluted projectile points created using bifacial percussion flaking - are created by Clovis culture peoples in the Plains and Southwestern North America
- 9250–8550 BCE: Monte Alegre culture rock paintings created at Caverna da Pedra Pintada become the oldest known paintings in South America.
- 9000 BCE: A man and child interred in a cave near Serranópolis in central Brazil are accompanied by necklaces of human teeth and mother of pearl
- 8500 BCE minimum age (could date back to 12,800 BCE): The Winnemucca Lake petroglyphs located near Winnemucca Lake, a dry lakebed in northwestern Nevada, are the earliest known petroglyphs in North America. They feature repeating designs of dots and arches, and other abstract designs.
- 8000 BCE: Fiberwork left in Guitarrero Cave, Peru is the earliest known example of textiles in South America
- 8200 BCE: Cooper Bison skull is painted with a red zigzag in present day Oklahoma, becoming the oldest known painted object in North America.
- 7650 BCE: Cave painting in the Toquepala Caves, Peru
- 7370±90: Stenciled hands are painted with mineral inks at the Cueva de las Manos, near Perito Moreno, Argentina, as well as images of humans, guanacos, rheas, felines, other animals, geometric shapes, the sun, and hunting scenes
- 7300 BCE: A painted herringbone design from Tecolate Cave in the Mojave Desert of California is the earliest well-dated pictograph in North America.
- 5630 BCE: Ceramics left at Caverna da Pedra Pintada, Brazil are the earliest known ceramics in the Americas
- 3450 BCE: Watson Brake, built by a hunter-gatherer society in Louisiana, is the earliest known mound complex in North America
- 2885 BCE: Valdivia culture pottery is created in coastal Ecuador
- 2600–2000 BCE: Monumental architecture, including platform mounds and sunken courtyards, built in Caral, Supe Valley; Asia; Aspero; Salinas de Chao; El Paraíso; La Galgada; and Kotosh, Peru
- 2500–1800 BCE: Elaborate twined textiles are created at Huaca Prieta in northern coastal Peru, part of the Norte Chico civilization
- 2000–1000 BCE: Poverty Point culture in northeastern Louisiana features stone work, flintknapping, earthenware, and effigy, conical, and platform mounds, as well as pre-planned settlements on concentric earthen ridges
- 1500 BCE–250 CE: Maya art is created in their Preclassic Period, in central and southeastern Mexico, Honduras, Guatemala, and El Salvador
- 1400–400 BCE: Olmec culture thrives in Norte Chico, the tropical lowlands of Mexico. Their art includes colossal basalt heads, jade sculpture, carved writing in stones, and ceramic effigy jars.
- 1000–900 BCE: The Cascajal Block is carved with writing by the Olmec people, becoming the earliest known example of writing in the Americas
- 1000–200 BCE: Adena culture, known for its mound building, originates in Ohio and expands to Indiana, West Virginia, Kentucky, and parts of Pennsylvania and New York.
- 900 BCE: Construction begins on Chavín de Huantar, a Chavin city in Callejón de Conchucos, Peru
- 900–200 BCE: Chavin synthesis flourishes in central coastal Peru and is characterized by monumental architecture, goldsmithing, stirrup spout ceramics, and Karwa textiles
- 750–100 BCE: Paracas culture flourishes in south coastal Peru
- 730 BCE: Porcupine quills used as binding agent in Utah and Nevada
- 500 BCE: Zapotec civilization emerges in the Valley of Oaxaca, Mexico. They are known for their ceramics, jewelry, and stonework.
- 200 BCE–500 CE: The Hopewell tradition flourishes in Ohio, Ontario, and surrounding area, featuring ceramics, cut mica, weaving, carved pipes, and jewelry.

**Common era**

- 1–600: Moche culture flourishes in northern coastal Peru, characterized by monumental adobe mounds, murals, metalwork, and ceramics
- 1–700: Nasca culture thrives in southern coastal Peru, characterized by double spout and bridge vessels and the Nasca lines, monumental geoglyphs
- 200–700: Maya civilization's Classic Period. Architecture, painting, stone glyphic writing, books, painting, ceramics, and Maya textiles created in central and southeastern Mexico, Honduras, Guatemala, and El Salvador
- 400–900: Tiwanaku culture emerges from Lake Titicaca and spreads to southern Peru, eastern Bolivia, and northern Chile
- 500–900: Wari culture dominates central coastal Peru
- 755±65–890±65: likely dates of the Blythe Geoglyphs being sculpted by ancestral Quechan and Mojave peoples in the Colorado Desert, California
800–1500: Mississippian cultures flourish in the Eastern Woodlands, featuring ceramics, shell engraving, textiles, woodcarving and stonework.

900: Earliest event recorded in the Battiste Good (1821–22, Sicangu Lakota) Winter count

900-1470: Chimú culture thrives in Chimor, today's north coastal Peru. Their art is characterized by monochromatic pottery; fine metal working of copper, gold, silver, bronze, and tumbago (copper and gold alloy); and monumental abode construction in their capital city Chan Chan

1000: Island of Marajó flourishes as an Amazonian ceramic center

1000–1200: Dresden Codex written and illuminated. This Yucatecan Mayan codex from Chichén Itzá is the earliest known surviving book from the Americas

1000–1200: Acoma Pueblo and Old Oraibi are established, become the oldest continuously inhabited communities in the United States

1070: Great Serpent Mound built in Ohio.

1100: Pueblo Bonito in Chaco Canyon reaches apex in size at 800 rooms

1100: Hohokam Culture reaches apex in present day Arizona

1142: Wampum invented by Ayenwatha, which the Haudenosaunee used to record information.

1200–1533: Inca civilization originated in the Peruvian highlands and spreads across western South America

1250: Cliff Palace, Mesa Verde, and other Ancestral Pueblo architectural complexes reach their apex

1325–1521: The Aztec Empire thrives, based in Tenochtitlan, central Mexico. Their arts are characterized by monumental stone architecture, turquoise mosaics, stone carving, ceramics, cotton textiles, and Aztec codices

1430: Construction of Machu Picchu begins, a classic example of Incan architecture

1479: Aztec Sun Stone, a monolithic calendar stone, almost 12 feet in diameter, is carved

1492: Glass beads are introduced to Taíno people

1500: Calusa culture flourishes in Key Marco, Florida, characterized by woodcarving

1500–1800: Navajo people learn loom-weaving techniques from Pueblo people

1600–1615: Felipe Guaman Poma de Ayala (Quechua) illustrates his 1,189-page book, El primer nueva corónica [sic] y buen gobierno.

1600–1650: Fernando de Alva Cortés Ixtlilxochitl (Texcocan, 1568/1580–1648) illustrates the Codex Ixtlilxochitl with watercolor paintings

1688: European and Mestizo members of the Cuzco School part ways with the Indian painters, allowing them to develop their own styles.
• 1725: Quebec Grey nuns and Mi'kmaq women devise new floral appliqué techniques in moose hair embroidery

19th century

• 1820s: Haida argillite carving emerges, in the wake of the declining Fur trade
• 1820s: Tuscarora brothers David and Dennis Cusick, both self-taught artists, begin painting, founding the Iroquois Realist Movement
• 1825: Ursuline nuns teach floral embroidery to Métis and Dene women in Fort Chipewyan and Winnipeg, which will revolutionize Great Lakes quillwork, embroidery, and beadwork
• 1830–1900: Tribes near Niagara Falls create beadwork whimsies, birch bark boxes, and other art forms, jumpstarting an active souvenir trade, following the decline in the fur trade
• 1840s: Zacharie Vincent (Huron, 1815–1886) begins his career as a realist oil painter
• 1853: Atsidi Sani (ca. 1830–1918) becomes the first known Navajo silversmith
• 1858–1869: Aron of Kangeq (1822–1869), a Kalaallit sculptor and carver, paints over 300 watercolors about traditional ways of life in Greenland, later to be published in books
• 1860s: Depletion of buffalo and forced relocation onto reservations causes Plains Indians to shift from hide painting to painting and drawing on cloth and paper, giving birth to Ledger art
• 1876: Mississauga Ojibwe sculptor Edmonia Lewis is the talk of the Centennial Exposition in Philadelphia for her monumental marble sculpture, The Death of Cleopatra.
• 1870–1900: Navajo weavers incorporate new Eyedazzler patterns and Germantown yarns.
• 1875–1878: Southern Plains artists imprisoned at Fort Marion become prolific Ledger artists
• 1885–1890: Nampeyo and her husband Lesou (Hopi) revive Síkyátki style pottery
• 1885–1905: Alaska native arts thrive in the curio trade precipitated by the Klondike Gold Rush
• 1890s: Silver Horn (Kiowa, 1860/1-1940) creates paintings for anthropologist James Mooney
• 1895: John Leslie (Puyallup) published a book of his photography at Carlisle Indian School and exhibits his photographs at the Atlanta International Exposition
• 1899: Tsimshian photographer Benjamin Haldane establishes a professional photography studio in Metlakatla, Alaska
20th century

- 1904: Louisiana Purchase Exposition in St. Louis, Missouri features Native American art, including paintings by Silver Horn (Kiowa) and Narcissa Chisholm Owen (Cherokee), art by Geronimo (Chiricahua Apache), and many others

- 1906–1915: Ho-Chunk artist Angel De Cora serves as director of Carlisle Indian School's Native American art program

- 1906: Carlisle Indian School builds state-of-the-art photography school and offers photography classes to its Native students

- 1910s: Maria Martinez (1881–1980, San Ildefonso Pueblo) revives her tribe's blackware ceramics

- 1910–1932: San Ildefonso Pueblo Painting Movement thrives in New Mexico, led by artists Crescencio Martinez, Julian Martinez, Alfredo Montoya, Tonita Peña, Alfonso Roybal, and Abel Sanchez

- 1914: Louisa Keyser, Washoe basket maker, experiences peak of her fame

- 1915: Iñupiaq men invent baleen basketry

- 1916: In a controversial move, Navajo weaver Hastiin Klah (1867–1937) incorporates Yeibichei imagery into a rug

- 1917: Quechua photographer Martín Chambi establishes his own photography studio in Peru

- 1917–1930s: Seminole women in Florida develop their unique patchwork appliqué designs

- 1918: Julian Martinez (San Ildefonso Pueblo) invents the matte-on-glossy blackware ceramic technique

- 1920s: The Kwakwaka'wakw Four (Chief George, Charley George, Sr., Willie Seaweed, and George Walkus) collaborate to revive and modernize Kwakwaka’wakw art

- 1922: Social Indigenist movement begins in Peru and thrives for three decades

- 1922: First Santa Fe Indian Market held, sponsored by the Museum of New Mexico

- 1925: Native Arts department of the Denver Art Museum was founded

- 1926: Indigenist Movement formed in Ecuador by Camilo Egas, Oswaldo Guayasamin, and other Quechua and Mestizo artists

- 1927: First Nations art exhibited with Euro-Canadian art in the Exhibition of the Canadian West Coast Art in the National Gallery of Canada in Ottawa

- 1928: Kiowa Five participate in the International Art Congress in Prague, Czech Republic

- 1931: Exposition of Indian Tribal Arts opens at the Grand Central Art Galleries in New York City. Sponsored by the Commissioner of Indian Affairs, the Secretary of the Interior, and the College Art Association, the exhibition of over 600 artworks then toured the Venice Biennale.
1932: Kiowa Five participate in the Venice Biennale. Their art, according to Dorothy Dunn, "was acclaimed the most popular exhibit among all the rich and varied displays assembled."

1932: Professor Mary Stone McClendon "Ataloa" (Chickasaw, 1895–1967) founds the Ataloa Art Lodge, a Native American art center at Bacone College, in Muskogee, Oklahoma

1932: The Studio at the Santa Fe Indian School is established by Dorothy Dunn

1933–34: Century of Progress Exposition, better known as the Chicago World's Fair features Native artists such as Navajo artists Fred Peshlaikai, Ah-Kena-Bah, and Hastiin Klah, as well as Maria and Julian Martinez, who won Best in Show.[53]

1934: Arts and Crafts of the Indians of the Southwest opens at the DeYoung Museum in San Francisco

1934–1941: The Seneca Indian Arts Project, a WPA-funded project at the Rochester Museum and Science Center, headed by Arthur C. Parker (Seneca), hires 70 Haudenosaunee artists to create almost 6,000 artworks[53]

1936: Indian Arts and Crafts Board created in the US

1938: Osage Nation establishes the oldest tribal museum in Pawhuska, Oklahoma

1939: Many Native artists participate in the 1939 New York World's Fair including realist landscape painter Moses Stranger Horse (Brulé Lakota, 1890–1941) and Fort Sill Apache sculptor Allan Houser (1914–1994)

1939: Hopi artist Fred Kabotie curates a Native American art show at the Golden Gate International Exposition in San Francisco

1941: Indian Art of the United States exhibition shows at the Museum of Modern Art, New York City

1946: Qualla Arts and Crafts is founded on the Qualla Boundary in North Carolina by Eastern Band Cherokee artists, becoming the first arts and crafts cooperative founded by Native Americans in the US

1948: Allan Houser completes his first monumental sculpture at the Haskell Indian School in Lawrence, Kansas

1950s and 1960s: Maya weaving cooperatives established by the Mexican government

1957: West Baffin Eskimo Co-op Ltd., an Inuit graphic arts workshop, is founded by James Archibald Houston in Cape Dorset, Nunavut.

1958: Yanktonai Dakota artist Oscar Howe (1915–1983) writes his famous letter after his work was rejected from the Philbrook Museum art show for not being "Indian" enough

1958: Heard Museum Guild hosts their first annual Indian Fair and Market in Phoenix, Arizona

1958–1962: Norval Morrisseau (Ojibwe) develops Woodlands Style painting in Ontario
• 1960: Oscar Howe appears on an episode of This Is Your Life, Ralph Edwards Productions, NBC, 13 April 1960. The guest host was Vincent Price. Among the surprise guests was Howe's former teacher, Dorothy Dunn.

• 1962: The Institute of American Indian Arts is founded in Santa Fe, New Mexico

• 1965: University of Alaska, Fairbanks creates their Native Art Center

• 1967: Fritz Scholder paints Indian No. 1, 1967, Oil paint on canvas, 20 x 18 in, the first of his famed Indian series paintings.

• 1967: Red Cloud Indian School in Pine Ridge, South Dakota hosts its first annual juried, competitive, intertribal art show which continues today

• 1971: The Cherokee Heritage Center in Park Hill, Oklahoma hosts the first Trail of Tears art show, an annual juried, competitive, intertribal art show which also continues today

• 1971: The Institute of American Indian Arts Museum (now called the Museum of Contemporary Native Arts) is founded by the Institute of American Indian Arts in Santa Fe, as the only museum to focus on contemporary intertribal Native American art

• 1972: Two American Painters shows at the Smithsonian Institution's National Collection of Fine Arts in Washington, DC, featuring T. C. Cannon (Kiowa-Caddo-Choctaw) and Fritz Scholder (Luiseño)

• 1977: Sna Jolobil (House of the Weaver) in San Cristobal de Las Casas, Mexico becomes the first artist-run Mayan weaving cooperative

• 1990: Native American Graves Protection and Repatriation Act passed in the US

• 1990: American Indian Arts and Crafts Act passed in the US

• 1992: Crow's Shadow Institute of the Arts, a center for fine printmaking, is founded by Walla Walla artist James Lavadour on the Umatilla Indian Reservation.

• 1992: Eiteljorg Museum hosts their first annual Indian Market and Festival

• 1995: Edward Poitras (Plains Cree) represents Canada at the Venice Biennale, with Gerald McMaster (Plains Cree) curating.


• 2000: Mapuche printmaker Santos Chávez is granted the Altazor award and named "illustrious son" of Tirúa, Chile

21st century

• 2004: National Museum of the American Indian opens its doors in Washington, DC
• 2005: Rebecca Belmore (Anishinaabe) represents Canada and James Luna (Luiseño) represents NMAI at the Venice Biennale.

• 2006: Chile hosts its first Biennial of Indigenous Art and Culture in Santiago, featuring over 120 artists from Chile's nine indigenous groups.

• 2006: The first Bienal Intercontinental de Arte Indígena (Intercontinental Indigenous Arts Biennial) is held in Quito, Ecuador

• 2009: Pottery by Jereldine Redcorn (Caddo), who singlehandedly revived her tribe's ceramic tradition, is exhibited in the Oval Office of the White House

Timeline of the Three Kingdoms period

180s

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>184</td>
<td>spring</td>
<td>Yellow Turban Rebellion: The Yellow Turbans ravage the north and east and are defeated</td>
</tr>
<tr>
<td></td>
<td>winter</td>
<td>Liang Province rebellion: A rebellion occurs in Liang province (Liangzhou; 涼州; roughly present-day Wuwei, Gansu)</td>
</tr>
<tr>
<td>185</td>
<td></td>
<td>The imperial palace is damaged by fire and special taxes are levied for rebuilding</td>
</tr>
<tr>
<td>188</td>
<td></td>
<td>Governors are appointed to unify provincial administrations</td>
</tr>
<tr>
<td>189</td>
<td>summer</td>
<td>Emperor Ling of Han dies; Empress He and her brother He Jin enthrone Liu Bian and establish a regency government</td>
</tr>
<tr>
<td></td>
<td>winter</td>
<td>The Ten Eunuchs kill He Jin and are themselves massacred by Yuan Shao; Dong Zhuo takes control of Luoyang and deposes Liu Bian in favor of his half-brother Liu Xie, Emperor Xian of Han</td>
</tr>
<tr>
<td>189</td>
<td></td>
<td>Campaign against Dong Zhuo: An anti-Dong Zhuo alliance forms in the east, led by Yuan Shao</td>
</tr>
</tbody>
</table>

190s

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>190</td>
<td></td>
<td>Dong Zhuo burns Luoyang, loots the imperials tombs, and relocates to Chang' an</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Battle of Xingyang: Dong Zhuo defeated Cao Cao at Xingyang, Henan</td>
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<tr>
<td></td>
<td></td>
<td>The Coalition breaks up and local officials set themselves up as warlords</td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>191</td>
<td></td>
<td>Cai Yong dies</td>
</tr>
<tr>
<td>192</td>
<td></td>
<td>Battle of Yangcheng: Battle between Yuan Shao and Yuan Shu</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Battle of Xiangyang: Sun Jian dies.</td>
</tr>
<tr>
<td>193</td>
<td></td>
<td>Zhang Lu sets up a theocracy in Hanzhong</td>
</tr>
<tr>
<td>194</td>
<td></td>
<td>Wang Yun and Lü Bu kill Dong Zhuo and Wang Yun himself is killed by Dong Zhuo's officers Li Jue and Guo Si</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cao Cao's invasion of Xu Province: Liu Bei first territory as a result of Cao Cao's campaign.</td>
</tr>
<tr>
<td>195</td>
<td></td>
<td>Battle of Yan Province: Cao Cao takes over Yan Province.</td>
</tr>
<tr>
<td>196</td>
<td></td>
<td>Emperor Xian of Han escapes from Chang'an</td>
</tr>
<tr>
<td>197</td>
<td></td>
<td>Sun Ce sets up south of the Changjiang, Sun Ce's conquests in Jiangdong begin.</td>
</tr>
<tr>
<td>198</td>
<td></td>
<td>Emperor Xian of Han relocates to Xuchang under Cao Cao's control</td>
</tr>
<tr>
<td>199</td>
<td></td>
<td>Campaign against Yuan Shu: Yuan Shu takes the imperial title but is driven south by Cao Cao</td>
</tr>
<tr>
<td></td>
<td></td>
<td>War between Cao Cao and Zhang Xiu begin.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Battle of Xiapi: Cao Cao and Liu Bei defeated Lu Bu.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Battle of Yijing: Yuan Shao eliminates Gongsun Zan in You Province.</td>
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<tr>
<td></td>
<td></td>
<td>Yuan Shu dies</td>
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</tbody>
</table>

200s

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
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<tbody>
<tr>
<td>200</td>
<td></td>
<td>Battle of Guandu: Yuan Shao is defeated by Cao Cao northeast of modern Zhongmou, Henan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sun Ce dies and is succeeded by his brother Sun Quan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zheng Xuan dies</td>
</tr>
<tr>
<td>202</td>
<td></td>
<td>Yuan Shao dies and is succeeded by his younger son Yuan Shang</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Battle of Xinye: Liu Bei defeats Cao Cao at Bowang (near present-day Fancheng District, Hubei)</td>
</tr>
<tr>
<td>203</td>
<td></td>
<td>Cao Cao's campaigns to unify northern China begin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Battle of Xiakou: Battle between the warlords Sun Quan and Liu Biao</td>
</tr>
<tr>
<td>207</td>
<td></td>
<td>Battle of White Wolf Mountain: Cao Cao defeats Yuan Shang and the Wuhuan, Cao Cao unites northern China</td>
</tr>
<tr>
<td>208</td>
<td></td>
<td>Battle of Jiangxia: Sun Quan defeats Liu Biao and beheads Huang Zu</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Zhuge Liang advises Liu Bei, Liu Biao dies, Cao Cao takes over Jing Province.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Battle of Changban: Zhao Yun rescues Liu Shan, Liu Bei escapes to Xiakou.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Battle of Red Cliffs: Cao Cao is defeated on the Changjiang, west of modern Jiangxia, Hubei, by Sun Quan and Liu Bei</td>
</tr>
</tbody>
</table>
### 210s

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>210</td>
<td></td>
<td>Liu Bei occupies the south of Jing Province</td>
</tr>
<tr>
<td>211</td>
<td></td>
<td><em>Battle of Tong Pass</em>: Cao Cao defeats Ma Chao and Han Sui and starts campaigning in northwestern China</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Liu Bei's takeover of Yi Province</em>: Liu Zhang invites Liu Bei to Yi Province (covering present-day Sichuan and Chongqing)</td>
</tr>
<tr>
<td>214</td>
<td></td>
<td><em>Liu Bei's takeover of Yi Province</em>: Liu Bei takes control of Yi Province from Liu Zhang</td>
</tr>
<tr>
<td>215</td>
<td></td>
<td><em>Battle of Yangping</em>: Zhang Lu surrenders Hanzhong to Cao Cao</td>
</tr>
<tr>
<td>216</td>
<td></td>
<td>Cao Cao declares himself King of Wei</td>
</tr>
<tr>
<td>219</td>
<td>spring</td>
<td><em>Battle of Mount Dingjun</em>: Liu Bei defeats and slays Cao Cao's general Xiahou Yuan and takes Hanzhong</td>
</tr>
<tr>
<td></td>
<td>autumn</td>
<td>Liu Bei becomes King of Hanzhong</td>
</tr>
<tr>
<td></td>
<td></td>
<td><em>Battle of Fancheng</em>: Liu Bei's general Guan Yu attacks north in Jing Province</td>
</tr>
<tr>
<td></td>
<td>winter</td>
<td><em>Lü Meng's invasion of Jing Province</em>: Sun Quan's general Lü Meng attacks Guan Yu and seizes the south of Jing Province</td>
</tr>
</tbody>
</table>

### 220s

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>220</td>
<td></td>
<td>Guan Yu is executed by Sun Quan</td>
</tr>
<tr>
<td></td>
<td>spring</td>
<td>Cao Cao dies at Luoyang and is succeeded by his son Cao Pi</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Nine-rank system is implemented</td>
</tr>
<tr>
<td></td>
<td>winter</td>
<td>Cao Pi forces Emperor Xian of Han to abdicate and declares himself Emperor of the Wei dynasty; so ends the Han dynasty</td>
</tr>
<tr>
<td>221</td>
<td></td>
<td>Liu Bei declares himself emperor of Han</td>
</tr>
<tr>
<td>222</td>
<td></td>
<td><em>Battle of Xiaoting</em>: Liu Bei is defeated by Sun Quan's general Lu Xun</td>
</tr>
<tr>
<td>223</td>
<td></td>
<td>Liu Bei dies and is succeeded by Liu Shan</td>
</tr>
<tr>
<td>225</td>
<td></td>
<td><em>Zhuge Liang's Southern Campaign</em>: Zhuge Liang conquers Nanzhong</td>
</tr>
<tr>
<td>226</td>
<td></td>
<td>Cao Pi dies and is succeeded by Cao Rui</td>
</tr>
<tr>
<td>228</td>
<td></td>
<td><em>Zhuge Liang's Northern Expeditions</em>: Ma Su is defeated by Zhang He</td>
</tr>
<tr>
<td>229</td>
<td></td>
<td>Sun Quan proclaims himself &quot;Emperor of Wu&quot; in Jianye (Nanjing; Wu enters an alliance with Shu Han)</td>
</tr>
</tbody>
</table>

### 230s
<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>230</td>
<td></td>
<td>Eastern Wu expedition troops land on an island known as Yizhou (suspected to be Taiwan) where most of them die but manage to bring back &quot;several thousand&quot; natives back to China</td>
</tr>
<tr>
<td>231</td>
<td></td>
<td>Zhuge Liang's Northern Expeditions: Zhuge Liang launches another expedition against Cao Wei but is forced to retreat after provisions are exhausted</td>
</tr>
<tr>
<td>232</td>
<td></td>
<td>Cao Zhi dies</td>
</tr>
<tr>
<td>233</td>
<td></td>
<td>Sun Quan sends an envoy to Gongsun Yuan in the northeast, but the envoy is killed and brought to Cao Wei</td>
</tr>
<tr>
<td>234</td>
<td></td>
<td>Battle of Wuzhang Plains: Zhuge Liang dies on his last campaign against Cao Wei</td>
</tr>
<tr>
<td>237</td>
<td></td>
<td>Gongsun Yuan declares himself King of Yan</td>
</tr>
<tr>
<td>238</td>
<td></td>
<td>Sima Yi's Liaodong campaign: Sima Yi kills Gongsun Yuan and annexes his territory</td>
</tr>
<tr>
<td>239</td>
<td></td>
<td>Cao Rui dies and is succeeded by Cao Fang but real power is wielded by the co-regents Sima Yi and Cao Shuang</td>
</tr>
</tbody>
</table>

**240s**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>245</td>
<td></td>
<td>Goguryeo–Wei War: Cao Wei general Guanqiu Jian defeats Goguryeo, taking Gungnae</td>
</tr>
<tr>
<td>249</td>
<td></td>
<td>Sima Yi kills Cao Shuang and He Yan</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wang Bi dies</td>
</tr>
</tbody>
</table>

**250s**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>251</td>
<td></td>
<td>Sima Yi dies and his son Sima Shi succeeds him</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Cao Wei divides the Southern Xiongnu into two parts to weaken their power</td>
</tr>
<tr>
<td>252</td>
<td></td>
<td>Sima Shi gains the title of &quot;Great General&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sun Quan dies and is succeeded by Sun Liang; Zhuge Ke assumes regency</td>
</tr>
<tr>
<td>253</td>
<td></td>
<td>Sun Jun kills Zhuge Ke</td>
</tr>
<tr>
<td>254</td>
<td></td>
<td>Sima Shi deposes Cao Fang and replaces him with Cao Mao</td>
</tr>
<tr>
<td>255</td>
<td></td>
<td>Sima Shi dies and his brother Sima Zhao takes over</td>
</tr>
<tr>
<td>256</td>
<td></td>
<td>Sun Jun dies</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wang Su dies</td>
</tr>
<tr>
<td>258</td>
<td></td>
<td>Sun Liang is deposed by Sun Chen and Sun Xiu succeeds him; the eunuch Huang Hao begins to dominate the court</td>
</tr>
<tr>
<td>259</td>
<td></td>
<td>Cao Wei forces are defeated by Goguryeo at Yangmaenggok</td>
</tr>
</tbody>
</table>
### 260s

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>260</td>
<td></td>
<td>Sima Zhao kills Cao Mao and replaces him with Cao Huan</td>
</tr>
<tr>
<td>262</td>
<td></td>
<td>Sima Zhao kills Ji Kang</td>
</tr>
<tr>
<td>263</td>
<td></td>
<td><em>Conquest of Shu by Wei</em>: Liu Shan surrenders to Sima Zhao; so ends Shu Han</td>
</tr>
<tr>
<td>264</td>
<td></td>
<td>Sima Zhao declares himself King of Jin</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sun Xiu dies and is succeeded by Sun Hao</td>
</tr>
<tr>
<td>265</td>
<td></td>
<td>Sima Zhao dies and is succeeded by Sima Yan</td>
</tr>
<tr>
<td>266</td>
<td></td>
<td>Sima Yan declares himself emperor of the Jin dynasty</td>
</tr>
</tbody>
</table>

### 270s

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>270</td>
<td></td>
<td>Qiao Zhou dies</td>
</tr>
</tbody>
</table>

### 280s

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>280</td>
<td></td>
<td><em>Conquest of Wu by Jin</em>: Sun Hao surrenders to Jin; so ends the Three Kingdoms period</td>
</tr>
</tbody>
</table>

### Timeline of Indian history

#### Pre 90th century BCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,000,000 – 100,000 BCE</td>
<td></td>
<td>A skull fragment found in Hathnora in the Narmada Valley in central India indicate that this part of Indian subcontinent might have been inhabited in the Middle Pleistocene era around 250,000 years ago. Anek R. Sankhyan describes it as &quot;debated and conveniently interpreted as &quot;evolved&quot; Homo erectus or &quot;archaic&quot;. Tools crafted by proto-humans that have been dated back two million years have been discovered in the northwestern part of the subcontinent. The earliest archaeological site in the subcontinent is the palaeolithic hominid site in the Soan River valley. Soanian sites are found in the Sivalik</td>
</tr>
</tbody>
</table>
region across what are now India, Pakistan, and Nepal. Some of the Bhimbetka shelters were inhabited by *Homo erectus* more than 100,000 years ago.

Madrasian culture sites have been found in Attirampakkam (Attrambakkam=13° 13' 50", 79° 53' 20"), which is located near Chennai (formerly known as Madras), Tamil Nadu. Thereafter, tools related to this culture have been found at various other locations in this region. Bifacial handaxes and cleavers are typical assemblages recovered of this culture. Flake tools, microliths and other chopping tools have also been found. Most of these tools were composed of the metamorphic rock quartzite. The stone tool artifacts in this assemblage have been identified as a part of the second inter-pluvial period in India. Evidence for presence of Hominins with Acheulean technology 150,000–100,000 BCE in Tamil Nadu.

Technology similar to contemporary artifacts found used by *Homo sapiens* in Africa found in Jwalapuram around 74000 BCE.

Paleolithic industries in South India Tamil Nadu 30,000 BCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>9,000 BCE</td>
<td>9,000 BCE</td>
<td>Early Neolithic culture with first confirmed semi permanent settlements appeared 11000 years ago in the Bhimbetka rock shelters in modern Madhya Pradesh, India. Some of the Stone Age rock paintings found among the Bhimbetka rock shelters are approximately 30,000 years old. The ancient history of the region includes some of South Asia's oldest settlements and some of its major civilisations.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000 BCE</td>
<td>4000 BCE</td>
<td>Phase of the Indus Valley Civilization begins. The civilization used an early form of the Indus signs, the so-called Indus script. Over the course of next 1000–1500 years, inhabitants of the Civilization developed new techniques in handicraft (carnelian products, seal carving) and metallurgy (copper, bronze, lead, and tin) had elaborate urban planning, baked brick houses, efficient drainage systems, water supply systems, and clusters of large non-residential buildings. The civilization depended significantly on trade, was the first civilization to use wheeled transport in form of bullock carts, and also used boats.</td>
</tr>
</tbody>
</table>
### 27th century BCE

<table>
<thead>
<tr>
<th>Year BCE</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2600 BCE</td>
<td></td>
<td>The cities of Harappa and Mohenjo-daro become large metropolises and the civilization expands to over 2,500 cities and settlements across the whole of Pakistan, much of northern India, and large parts of Afghanistan, covering a region of around one million square miles, which was larger than the land area of its contemporaries Egypt and Mesopotamia combined, and also had superior urban planning and sewage systems. The civilization uses the Indus script.</td>
</tr>
<tr>
<td>2600 BCE</td>
<td></td>
<td>End of the Early Dynastic II Period and the beginning of the Early Dynastic IIIa Period in Mesopotamia.</td>
</tr>
<tr>
<td>2900 BCE – 2334 BCE</td>
<td></td>
<td>Mesopotamian wars of the Early Dynastic period.</td>
</tr>
</tbody>
</table>

### 18th century BCE

<table>
<thead>
<tr>
<th>Year BCE</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1800 BCE</td>
<td></td>
<td>Adichanallur urn-burial site in Tirunelveli district in Tamil Nadu. In 2004, a number of skeletons dating from around 3,800 years ago.</td>
</tr>
</tbody>
</table>

### 15th century BCE

<table>
<thead>
<tr>
<th>Year BCE</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1500 BCE</td>
<td></td>
<td>Early Vedic Period (to 1000 BCE)</td>
</tr>
</tbody>
</table>

### 13th century BCE

<table>
<thead>
<tr>
<th>Year BCE</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1300 BCE</td>
<td></td>
<td>Cemetery H culture comes to an end</td>
</tr>
</tbody>
</table>

### 12th century BCE

<table>
<thead>
<tr>
<th>Year BCE</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1200 BCE</td>
<td></td>
<td>Rigveda (to 1000 BCE)</td>
</tr>
</tbody>
</table>
10th century BCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000 BCE</td>
<td></td>
<td>Middle and Late Vedic period (to 500 BCE)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iron Age India</td>
</tr>
<tr>
<td>1000 – 300 BCE</td>
<td></td>
<td>Kanchi district, gold mine of Megalithic sites in Tamil Nadu, South India</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Iron Age kingdoms rule India— Kuru, Panchala, Kosala, Videha.</td>
</tr>
</tbody>
</table>

9th century BCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>877 BCE</td>
<td></td>
<td>Birth of Parsvanatha, 23rd Jain Tirthankara (traditional date)</td>
</tr>
</tbody>
</table>

7th century BCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>700 BCE</td>
<td></td>
<td>The Upanishads, a sacred text of Hinduism, are written.</td>
</tr>
</tbody>
</table>

6th century BCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>600 BCE</td>
<td></td>
<td>Sixteen Maha Janapadas (&quot;Great Realms&quot; or &quot;Great Kingdoms&quot;) emerge. Vedic period ends.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The capital of the Early Pandyan Kingdom was initially Korkai, all around 600 BCE, and was later moved to Koodal (now Madurai) during the reign of Nedunjeliyan I.</td>
</tr>
<tr>
<td>599 BCE</td>
<td></td>
<td>Mahavira, 24th Tirthankar of Jainism is born (traditional date).</td>
</tr>
<tr>
<td>563 BCE</td>
<td></td>
<td>Siddhärtha Gautama, Buddha-to-be, is born in Lumbini into a leading royal family in the republic of the Shakyas, which is now part of Nepal.</td>
</tr>
<tr>
<td>543 BCE</td>
<td></td>
<td>The Vanga-based Prince Vijaya (c. 543 BCE) married a daughter of the Pandyan king of Madurai, to whom he was sending rich presents every year. Sinhala chronicle Mahawamsa mentions this event</td>
</tr>
<tr>
<td>538 BCE</td>
<td></td>
<td>Cyrus the Great, founder of the Persian Achaemenid Empire reached up to northwestern parts of the Indian subcontinent, today's Afghanistan, which later proved to be his nemesis and caused his death.</td>
</tr>
<tr>
<td>527 BCE</td>
<td></td>
<td>Nirvana of Mahavira</td>
</tr>
</tbody>
</table>
## 5th century BCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>483 BCE</td>
<td></td>
<td>Proposed Mahaparinirvana date of Gautama Buddha at Kushinagar.</td>
</tr>
</tbody>
</table>

## 4th century BCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>400 BCE</td>
<td></td>
<td>Siddharta Gautama 'Buddha' of the Shakya polity in S. Nepal, founds Buddhism (older date: 563–483 BCE)</td>
</tr>
<tr>
<td>350 BCE</td>
<td></td>
<td>Panini, a resident of Gandhara, describes the grammar and morphology of Sanskrit in the text Ashtadhyayi. Panini's standardized Sanskrit is known as Classical Sanskrit.</td>
</tr>
<tr>
<td>333 BCE</td>
<td></td>
<td>Persian rule in the northwest ends after Darius 3 is defeated by Alexander the Great, who establishes the Macedonian Empire after inheriring the Persian Achaemenid Empire.</td>
</tr>
<tr>
<td>326 BCE</td>
<td></td>
<td>Ambhi king of Takshila surrenders to Alexander.</td>
</tr>
<tr>
<td>321 BCE</td>
<td></td>
<td>Porus who ruled parts of the Punjab, fought Alexander at the Battle of the Hydaspes River.</td>
</tr>
<tr>
<td>305 BCE</td>
<td></td>
<td>Chandragupta Maurya defeats Seleucus Nicator of the Seleucid Empire.</td>
</tr>
<tr>
<td>304 BCE</td>
<td></td>
<td>Seleucus gives up his territories in the subcontinent (Afghanistan/Baluchistan) to Chandragupta in exchange for 500 elephants. Seleucus offers his daughter in marriage to Chandragupta to seal their friendship.</td>
</tr>
</tbody>
</table>

## 3rd century BCE

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>273 BCE</td>
<td></td>
<td>Ashoka the Great regarded as the greatest ancient Indian emperor, grandson of Chandragupta Maurya, ascends as emperor of the Mauryan Empire.</td>
</tr>
<tr>
<td>266 BCE</td>
<td></td>
<td>Ashoka conquers and unifies most of South Asia, along with most of Afghanistan and Balochistan.</td>
</tr>
<tr>
<td>265 BCE</td>
<td></td>
<td>Kalinga War takes place between Ashoka and the kingdom of Kalinga.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>After conquering Kalinga, Ashoka reportedly regrets what he has done, leading him to</td>
</tr>
<tr>
<td>Year BCE</td>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>----------</td>
<td>------</td>
<td>-------</td>
</tr>
<tr>
<td>261</td>
<td></td>
<td>Conquest of Kalinga</td>
</tr>
<tr>
<td>260</td>
<td></td>
<td>Ashoka inscribes the Edicts of Ashoka, written down using Brahmi script. The Edicts describe his Buddhist religious views and his commitment to the welfare of his subjects.</td>
</tr>
<tr>
<td>232</td>
<td></td>
<td>Ashoka dies and is succeeded by Kunala.</td>
</tr>
<tr>
<td>230</td>
<td></td>
<td>Simuka declares independence from Mauryan rule and establishes the Satavahana Empire.</td>
</tr>
</tbody>
</table>

**2nd century BCE**

<table>
<thead>
<tr>
<th>Year BCE</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>200</td>
<td></td>
<td>Kuninda Kingdom is established.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tholkappiyam describes the grammar and morphology of Tamil; it is the oldest existing Tamil grammar (dates vary between 200 BCE and 100 CE). (to 100 BC)</td>
</tr>
<tr>
<td>184</td>
<td></td>
<td>The Mauryan Empire, declines</td>
</tr>
</tbody>
</table>

**1st century BCE**

<table>
<thead>
<tr>
<th>Year BCE</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>65</td>
<td></td>
<td>The Pandyan king sends ambassadors to the Greek and Roman lands.</td>
</tr>
<tr>
<td>58</td>
<td></td>
<td>Beginning of Vikram Era</td>
</tr>
</tbody>
</table>

**1st century**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>35</td>
<td></td>
<td>Western Satraps formed.</td>
</tr>
<tr>
<td>68</td>
<td></td>
<td>Establishment of the Kushan empire by Kujula Kadphises.</td>
</tr>
<tr>
<td>78</td>
<td></td>
<td>Gautamiputra Satkarni becomes Satavahana emperor and starts Shalivahana era calendar after defeating Scythian king Maues.</td>
</tr>
<tr>
<td>100 or after</td>
<td></td>
<td>Sugar was first produced from sugarcane plants in northern India sometime after the first century.</td>
</tr>
</tbody>
</table>

**3rd century**
<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>240</td>
<td></td>
<td>Sri-Gupta starts the Gupta Empire in Magadha, with its capital in Pataliputra</td>
</tr>
</tbody>
</table>

4th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>320</td>
<td></td>
<td>Chandragupta I ascends the Gupta throne.</td>
</tr>
<tr>
<td>335</td>
<td></td>
<td>Samudragupta ascends the Gupta throne and expands the empire.</td>
</tr>
<tr>
<td>345</td>
<td></td>
<td>Kadamba Kingdom established by Mayurasharma, Banavasi as its capital and they were the first kingdom to use Kannada in administration.</td>
</tr>
<tr>
<td>375</td>
<td></td>
<td>Vakataka Empire in the Deccan</td>
</tr>
<tr>
<td>380</td>
<td></td>
<td>Chandragupta II, Samudragupta's son becomes the Gupta Emperor.</td>
</tr>
<tr>
<td>413</td>
<td></td>
<td>Kumaragupta I, Adopted the title of Mahendraditya.</td>
</tr>
<tr>
<td>455</td>
<td></td>
<td>Skandagupta, Faced Hunas effectively.</td>
</tr>
</tbody>
</table>

5th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>467</td>
<td></td>
<td>Invasions by the Huna. Pallavas became a major power during the reign of Mahendravarman I (571 – 630 CE)</td>
</tr>
</tbody>
</table>

6th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>554</td>
<td></td>
<td>Collapse of Gupta Empire after the death of Vishnugupta.</td>
</tr>
</tbody>
</table>

7th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>606</td>
<td></td>
<td>Harshavardhana crowned Monarch.</td>
</tr>
<tr>
<td>637</td>
<td></td>
<td>Badami Chalukya power at its peak. Pulakeshin II pushes north up to the Narmada and defeats the invading Harshavardhana of Kanauj</td>
</tr>
</tbody>
</table>

8th century

| Year | Date | Event |
According to the Qissa-i Sanjan, the immigrants Parsi are granted permission to stay by the local ruler Jadi Rana

First Muslim, Muhammad Bin Qasim defeats Raja Dahir, king of Sindh Region in modern-day Pakistan

Delhi is re-established by Bilan Deo Tomar also known as Anangpal Tomar

Establishment of Rashtrakuta Kingdom of Manyakhet by Danti Durga by defeating Chalukyas of Badami

Birth of Adi Shankaracharya

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>814</td>
<td></td>
<td>Nripatunga Amoghavarsha I becomes Rashtrakuta emperor. Kannada literature flourishes.</td>
</tr>
<tr>
<td>836</td>
<td></td>
<td>Gurjara-Pratihara (to 910)</td>
</tr>
</tbody>
</table>

Rajaraja Chola ascends to the throne of Chola empire. He expands the empire to Sri Lanka and to the north to include Kalinga kingdom

Invasion of Mahmud of Ghazni

Rajendra Chola I became the king of Chola empire after his father Rajaraja Chola. During his reign, he extended the influences of the already vast Chola empire up to the banks of the river Ganges in the north and across the ocean. Rajendra's territories extended coastal Burma, the Andaman and Nicobar Islands, Lakshadweep, Maldives, conquered the kings of Srivijaya (Sumatra, Java and Malay Peninsula in South East Asia) and Pegu islands with his fleet of ships. He defeated Mahipala, the Pala king of Bengal and Bihar, and to commemorate his victory he built a new capital called Gangaikonda Cholapuram. The Cholas became one of the most powerful dynasties in Asia during his reign. The Tamil Chola armies exacted tribute from Thailand and the Khmer kingdom of Cambodia. Rajendra Chola I was the first Indian king to take his armies overseas and make conquests of these territories, even though there is epigraphical evidence of Pallava presence in these very areas.
<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1017</td>
<td>26 April</td>
<td>Sri Ramanujacharya is born at Sriperumbudur, Tamil Nadu.</td>
</tr>
<tr>
<td>1021</td>
<td></td>
<td>Mahmud Ghazni defeats Tarnochalpal and annexes Punjab</td>
</tr>
<tr>
<td>1025</td>
<td>30 April</td>
<td>Last invasion of Mahmud Ghazni, sacked and destroyed temple of Somnath</td>
</tr>
<tr>
<td>1030</td>
<td>30 April</td>
<td>Alberuni arrives in India; death of Mahmud of Ghazni</td>
</tr>
<tr>
<td>1058</td>
<td></td>
<td>Sumra Dynasty ends the Arab domination and establishes its own rule over Sindh.</td>
</tr>
</tbody>
</table>

### 12th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1120</td>
<td></td>
<td>Kalyani Chalukyas power at its peak. Vikramaditya VI ushers in Vikrama Chalukya era.</td>
</tr>
<tr>
<td>1134</td>
<td></td>
<td>Life of Basaveshwara, philosopher and social reformer. (to 1196)</td>
</tr>
<tr>
<td>1157</td>
<td></td>
<td>The Kalachuris of Kalyani under Bijjala II capture Kalyani</td>
</tr>
<tr>
<td>1175</td>
<td></td>
<td>Muhammad of Ghor invades India.</td>
</tr>
<tr>
<td>1191</td>
<td></td>
<td>&quot;Victory of Prithviraj Chauhan&quot;. First Battle of Tarain between Mohammed Ghori and Prithviraj III. Ghori is defeated by Prithvi Raj Chauhan III.</td>
</tr>
<tr>
<td>1192</td>
<td></td>
<td>&quot;Victory of Mohammed Ghori&quot;. Second Battle of Tarain fought between Ghori and Prithvi Raj Chauhan III. Prithvi Raj Chauhan III is defeated by Mohammed Ghori.</td>
</tr>
<tr>
<td>1194</td>
<td></td>
<td>Battle of Chandawar fought between Muhammad of Ghor and Jaichand of Kannauj. Ghori defeated Jayachandra and killed him.</td>
</tr>
</tbody>
</table>

### 13th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1206</td>
<td>15 March</td>
<td>Khukhrain kill Muhammad Ghori during a raid on his camp on the Jhelum River</td>
</tr>
<tr>
<td>1206</td>
<td>12 June</td>
<td>Qutb-ud-din Aibak establishes slave Dynasty later to be known as Delhi Sultanate</td>
</tr>
<tr>
<td>1210</td>
<td></td>
<td>Qutb-ud-din Aibak died while playing polo.</td>
</tr>
<tr>
<td>1210</td>
<td></td>
<td>Shams ud-Din Iltutmish was the third ruler of the Delhi Sultanate, belonging to the Mamluk dynasty (Slave Dynasty). He introduced IQTA (Tax, revenue) system. Died in 1236</td>
</tr>
<tr>
<td>1221</td>
<td></td>
<td>Genghis Khan invades Punjab during rule of Iltutmish</td>
</tr>
<tr>
<td>1236</td>
<td>10 November</td>
<td>Rule of Razia Sultana – Daughter of Iltutmish.</td>
</tr>
<tr>
<td>1238</td>
<td>October</td>
<td>Sri Madhwacharya born in Pajaka near Udupi, Karnataka</td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>------</td>
<td>--------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1240</td>
<td>14 October</td>
<td>Murder of Razia Sultan by Turkish nobles. (Chalisa)</td>
</tr>
<tr>
<td>1246–66</td>
<td></td>
<td>Rule of Nasiruddin Mahmud with support of Balban (Wazir and powerful member of Chalisa). Chalisa - a council of 40 members</td>
</tr>
<tr>
<td>1266–1286</td>
<td></td>
<td>Rule of Balban; Chalisa wiped out.</td>
</tr>
<tr>
<td>1267</td>
<td></td>
<td>The Mahanubhava philosophy established by Chakradhar Swami.</td>
</tr>
<tr>
<td>1275</td>
<td></td>
<td>Birth of saint Dnyaneshwar.</td>
</tr>
<tr>
<td>1290</td>
<td></td>
<td>Murder of Muiz ud din Qaiqabad by Jalaluddin Firuz Khalji, an army commander.</td>
</tr>
<tr>
<td>1290–96</td>
<td></td>
<td>Jalal-ud-din Khilji. Founder of Khilji Dynasty</td>
</tr>
<tr>
<td>1309</td>
<td></td>
<td>Alauddin Khalji sends Malik Kafur to South. Malik Kafur Lays siege on the Kakatiya Capital Warangal and Extracts Tribute. The diamond Kohinoor was among the loot collected.</td>
</tr>
<tr>
<td>1310</td>
<td></td>
<td>Ala-ud-din Khilji's army under Malik Kafur occupies Devagiri ending the Seuna Yadava Kingdom</td>
</tr>
<tr>
<td>1311</td>
<td></td>
<td>Malik Kafur attacks the Hoyasalas. In the aftermath of the destruction Hoyasalas abandon the old capital Halebidu. He later attacks Madurai. The attacks on Warangal, Halebidu and Madurai is accompanied by wide scale killing, destruction of temples and repatriation of wealth back to Delhi.</td>
</tr>
<tr>
<td>1323</td>
<td></td>
<td>Ulugh Khan defeats Prataparudra II ending the Kakatiya dynasty</td>
</tr>
<tr>
<td>1336</td>
<td></td>
<td>Vijayanagara Empire established by Harihara I and his brother Bukka Raya I</td>
</tr>
<tr>
<td>1340</td>
<td></td>
<td>Birth of great mathematician Madhava of Sangamagrama.</td>
</tr>
<tr>
<td>1343</td>
<td></td>
<td>Veera Ballala III was killed at the Battle of Madurai.</td>
</tr>
<tr>
<td>1347</td>
<td></td>
<td>Governor Hasan Gangu revolts against Muhammad bin Tughluq founding the Bahmani Sultanate</td>
</tr>
<tr>
<td>1351</td>
<td></td>
<td>Samma Dynasty assumes rule over Sindh</td>
</tr>
<tr>
<td>1370</td>
<td></td>
<td>Bukka, the Vijayanagara ruler and his son Kumara Kamapna capture the entire Tamil speaking parts.</td>
</tr>
<tr>
<td>1398</td>
<td></td>
<td>Timur plunders Lahore</td>
</tr>
<tr>
<td>1398</td>
<td></td>
<td>Shri Guru Ravidas Ji was born in 1398 in Varanasi. He was an Indian mystic poet-sant of the Bhakti movement during the 15th to 16th century CE. Venerated as a guru in the region of Punjab, Uttar Pradesh, Rajasthan, Maharashtra and Madhya Pradesh, the devotional songs of Ravidas have had a lasting impact upon the bhakti movement. Wikipedia Born</td>
</tr>
</tbody>
</table>

**14th century**

**15th century**
<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1401</td>
<td></td>
<td>Dilawar Khan establishes the Malwa Sultanate in present-day northern India</td>
</tr>
<tr>
<td>1407</td>
<td></td>
<td>Zafar Khan: governor of Gujarat, declares himself as Sultan Muzaffar Shah founding the Gujarat Sultanate/Muzaffarid dynasty</td>
</tr>
<tr>
<td>1414</td>
<td></td>
<td>Khizr Khan, deputized by Timur to be the governor of Multan takes over Delhi founding the Sayyid dynasty</td>
</tr>
<tr>
<td>1424</td>
<td></td>
<td>Deva Raya II succeeded his father Veera Vijaya Bukka Raya as monarch of the Vijayanagara Empire</td>
</tr>
<tr>
<td>1443</td>
<td></td>
<td>Abdur Razzaq visits India</td>
</tr>
<tr>
<td>1446</td>
<td></td>
<td>Mallikarjuna Raya succeeds his father Deva Raya II</td>
</tr>
<tr>
<td>1449</td>
<td>26 September</td>
<td>Sankardev, founder of Ekasarana Dharma was born in Nagaon, Assam.</td>
</tr>
<tr>
<td>1451</td>
<td>19 April</td>
<td>Bahlul Khan Lodhi ascends the throne of the Delhi sultanate starting the Lodhi dynasty</td>
</tr>
<tr>
<td>1469</td>
<td>15 April</td>
<td>Guru Nanak, the founder of Sikhism is born</td>
</tr>
<tr>
<td>1483</td>
<td>14 February</td>
<td>Birth of Babur in Andijan, Fergana Valley in Central Asia</td>
</tr>
<tr>
<td>1485</td>
<td></td>
<td>Saluva Narasimha Deva Raya drives out Praudha Raya ending the Sangama Dynasty</td>
</tr>
<tr>
<td>1486</td>
<td></td>
<td>Advent of Chaitanya Mahaprabhu, founder of Gaudiya Vaishnavism and leader of the world's first civil disobedience movement, in Navadwip, West Bengal</td>
</tr>
<tr>
<td>1490</td>
<td></td>
<td>Ahmadnagar declares independence, followed by Bijapur and Berar in the same year thus breaking up the Bahmani Sultanate.</td>
</tr>
<tr>
<td>1494</td>
<td>9 June</td>
<td>Babur becomes the King</td>
</tr>
<tr>
<td>1498</td>
<td>20 May</td>
<td>Vasco de Gama's first voyage from Europe to India and back (to 1499)</td>
</tr>
</tbody>
</table>

16th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1503</td>
<td></td>
<td>Kingdom of Cochin is taken over by the Portuguese creating the first European settlement in India.</td>
</tr>
<tr>
<td>1508</td>
<td>3 February</td>
<td>The Christian-Islamic power struggle in Europe and the Middle East. Spills over into the Indian Ocean as Battle of Chaul during the Portuguese-Mamluk War</td>
</tr>
<tr>
<td>1509</td>
<td>3 February</td>
<td>Battle of Diu marks the beginning of the dominance of the Europeans in the Asian naval theater.</td>
</tr>
<tr>
<td>1510</td>
<td>20 May</td>
<td>Portuguese India (to 1961)</td>
</tr>
<tr>
<td>1522</td>
<td></td>
<td>Portuguese land on the Coromandel Coast</td>
</tr>
<tr>
<td>1526</td>
<td>21 April</td>
<td>Sultan Ibrahim Lodhi, of the Delhi Sultanate, angers local nobles, who respond by inviting Babur, the Mughal ruler of Kabul, to invade Delhi and Agra. The local population,</td>
</tr>
</tbody>
</table>
plus the possession of artillery, assists Babur in killing the Sultan (whose soldiers desert him) at the Battle of Panipat.

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1527</td>
<td>17 March</td>
<td>Babur bribes Mewar general Silhadi promising Silhadi a kingdom, if Silhadi betrays Mewar King Rana Sanga in Battle of Khanwa, thus leading to the annexation of Mewar.</td>
</tr>
<tr>
<td>1530</td>
<td>28 March, 27 January</td>
<td>Babur completes his Baburnama, reflecting on society, politics, economics, history, geography, nature, flora and fauna, which to this day is a standard textbook in 25 countries. Babur dies, and is succeeded by his son Humayun.</td>
</tr>
<tr>
<td>1539</td>
<td></td>
<td>Battle of Chausa fought between Humayun and Sher Shah Suri in which Humayun defeated.</td>
</tr>
<tr>
<td>1540</td>
<td>18 September</td>
<td>Battle of Kannauj fought between Humayun and Sher Shah Suri and Humayun was completely defeated. Humayun lost the Mughal empire to Afghans (Suri Dynasty), and passed 12 years in exile.</td>
</tr>
<tr>
<td>1545</td>
<td>22 May</td>
<td>Death of Shri Guru Ravidas Ji</td>
</tr>
<tr>
<td>1546</td>
<td>9 May</td>
<td>Birth of Maharana Pratap Singh of Mewar (son of Maharana Udai Singh II)</td>
</tr>
<tr>
<td>1552</td>
<td>26 March</td>
<td>Guru Amar Das becomes third Guru of Sikhs.</td>
</tr>
<tr>
<td>1554</td>
<td>22 November</td>
<td>Death of Islam Shah Suri.</td>
</tr>
<tr>
<td>1555</td>
<td>22 May</td>
<td>Humayun regained the throne of Delhi from the hands of weak successors of Sher Shah.</td>
</tr>
<tr>
<td>1556</td>
<td>5 November</td>
<td>Hindu king Hemu establishes 'Hindu Raj' in North India and bestowed with title of &quot;Vikramaditya&quot;; Second Battle of Panipat fought between Hemu and Akbar's forces in which Hemu is killed.</td>
</tr>
<tr>
<td>1557</td>
<td>26 January</td>
<td>Death of Sher Shah Suri and succeeded by Islam Shah Suri.</td>
</tr>
<tr>
<td>1558</td>
<td>18 September</td>
<td>Battle of Kannauj fought between Humayun and Sher Shah Suri and Humayun was completely defeated. Humayun lost the Mughal empire to Afghans (Suri Dynasty), and passed 12 years in exile.</td>
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<td>1565</td>
<td>22 May</td>
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</tr>
<tr>
<td>1566</td>
<td>9 May</td>
<td>Birth of Maharana Pratap Singh of Mewar (son of Maharana Udai Singh II)</td>
</tr>
<tr>
<td>1571</td>
<td>22 May</td>
<td>Death of Sher Shah Suri and succeeded by Islam Shah Suri.</td>
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<tr>
<td>1572</td>
<td>26 March</td>
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</tr>
<tr>
<td>1574</td>
<td>22 November</td>
<td>Death of Islam Shah Suri.</td>
</tr>
<tr>
<td>1575</td>
<td>22 May</td>
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<td>1576</td>
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<td>22 May</td>
<td>Death of Shri Guru Ravidas Ji</td>
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<tr>
<td>1580</td>
<td>9 May</td>
<td>Birth of Maharana Pratap Singh of Mewar (son of Maharana Udai Singh II)</td>
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<tr>
<td>1581</td>
<td>22 May</td>
<td>Death of Sher Shah Suri and succeeded by Islam Shah Suri.</td>
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<tr>
<td>1582</td>
<td>26 March</td>
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<td>1583</td>
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<td>22 May</td>
<td>Death of Shri Guru Ravidas Ji</td>
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<tr>
<td>1589</td>
<td>9 May</td>
<td>Birth of Maharana Pratap Singh of Mewar (son of Maharana Udai Singh II)</td>
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<td>1590</td>
<td>22 May</td>
<td>Death of Sher Shah Suri and succeeded by Islam Shah Suri.</td>
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<td>26 March</td>
<td>Guru Amar Das becomes third Guru of Sikhs.</td>
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<td>22 November</td>
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<td>1595</td>
<td>26 January</td>
<td>Death of Sher Shah Suri and succeeded by Islam Shah Suri.</td>
</tr>
<tr>
<td>1596</td>
<td>18 September</td>
<td>Battle of Kannauj fought between Humayun and Sher Shah Suri and Humayun was completely defeated. Humayun lost the Mughal empire to Afghans (Suri Dynasty), and passed 12 years in exile.</td>
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<tr>
<td>1597</td>
<td>22 May</td>
<td>Death of Shri Guru Ravidas Ji</td>
</tr>
<tr>
<td>1598</td>
<td>9 May</td>
<td>Birth of Maharana Pratap Singh of Mewar (son of Maharana Udai Singh II)</td>
</tr>
<tr>
<td>1599</td>
<td>22 May</td>
<td>Death of Sher Shah Suri and succeeded by Islam Shah Suri.</td>
</tr>
<tr>
<td>1600</td>
<td>26 March</td>
<td>Guru Amar Das becomes third Guru of Sikhs.</td>
</tr>
<tr>
<td>1601</td>
<td>22 November</td>
<td>Death of Islam Shah Suri.</td>
</tr>
<tr>
<td>1602</td>
<td>22 May</td>
<td>Humayun regained the throne of Delhi from the hands of weak successors of Sher Shah.</td>
</tr>
<tr>
<td>1603</td>
<td>5 November</td>
<td>Hindu king Hemu establishes 'Hindu Raj' in North India and bestowed with title of &quot;Vikramaditya&quot;; Second Battle of Panipat fought between Hemu and Akbar's forces in which Hemu is killed.</td>
</tr>
<tr>
<td>1604</td>
<td>26 January</td>
<td>Death of Sher Shah Suri and succeeded by Islam Shah Suri.</td>
</tr>
<tr>
<td>1605</td>
<td>18 September</td>
<td>Battle of Kannauj fought between Humayun and Sher Shah Suri and Humayun was completely defeated. Humayun lost the Mughal empire to Afghans (Suri Dynasty), and passed 12 years in exile.</td>
</tr>
<tr>
<td>1606</td>
<td>22 May</td>
<td>Death of Shri Guru Ravidas Ji</td>
</tr>
<tr>
<td>1607</td>
<td>9 May</td>
<td>Birth of Maharana Pratap Singh of Mewar (son of Maharana Udai Singh II)</td>
</tr>
<tr>
<td>1608</td>
<td>22 May</td>
<td>Death of Sher Shah Suri and succeeded by Islam Shah Suri.</td>
</tr>
<tr>
<td>1609</td>
<td>26 March</td>
<td>Guru Amar Das becomes third Guru of Sikhs.</td>
</tr>
<tr>
<td>1610</td>
<td>22 November</td>
<td>Death of Islam Shah Suri.</td>
</tr>
<tr>
<td>1611</td>
<td>22 May</td>
<td>Humayun regained the throne of Delhi from the hands of weak successors of Sher Shah.</td>
</tr>
<tr>
<td>1612</td>
<td>5 November</td>
<td>Hindu king Hemu establishes 'Hindu Raj' in North India and bestowed with title of &quot;Vikramaditya&quot;; Second Battle of Panipat fought between Hemu and Akbar's forces in which Hemu is killed.</td>
</tr>
</tbody>
</table>

17th century
<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1605</td>
<td>27 October</td>
<td>Akbar dies, and is succeeded by his son Jahangir.</td>
</tr>
<tr>
<td>1606</td>
<td>25 May</td>
<td>Guru Hargobind becomes sixth guru of Sikhs.</td>
</tr>
<tr>
<td>1612</td>
<td>30 November</td>
<td>British India (to 1947)</td>
</tr>
<tr>
<td></td>
<td>24 August</td>
<td>East India Company (to 1857 – Indian Rebellion of 1857, Meerut)</td>
</tr>
<tr>
<td>1627</td>
<td>19 February</td>
<td>Birth of Shivaji.</td>
</tr>
<tr>
<td>1628</td>
<td></td>
<td>Jahangir announces &quot;Chain of Justice&quot; outside his palace that anyone can ring the bell and get a personal hearing with the emperor. Jahangir dies, and is succeeded by his son Shah Jahan.</td>
</tr>
<tr>
<td>1644</td>
<td>8 March</td>
<td>Guru Har Rai becomes seventh guru of Sikhs</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Shivaji takes oath of Independence at Raiershwar.</td>
</tr>
<tr>
<td>1658</td>
<td></td>
<td>Shah Jahan completes Taj Mahal, Jama Masjid, and Red Fort. Imperial treasuries drained by architectural and military overexpenditures. Shah Jahan put under house arrest, and is succeeded by his son Aurangzeb.</td>
</tr>
<tr>
<td>1659</td>
<td>19 February</td>
<td>Shivaji’s ill-equipped and small Maratha army defeat numerically much larger Adilshahi troops at the Battle of Pratapgarh marking the first victory of the Maratha Empire. Shivaji personally kills Adilshahi commander Afzal Khan (general).</td>
</tr>
<tr>
<td>1661</td>
<td>6 October</td>
<td>Guru Har Krishan becomes eighth guru of Sikhs.</td>
</tr>
<tr>
<td>1665</td>
<td>20 March</td>
<td>Guru Tegh Bahadur becomes ninth Guru of Sikhs.</td>
</tr>
<tr>
<td>1665</td>
<td>11 June</td>
<td>Treaty of Purandar (1665) (or पूरंदर चा तह) was signed on 11 June 1665, between the Rajput ruler Jai Singh I</td>
</tr>
<tr>
<td>1674</td>
<td></td>
<td>Forces led by Shivaji defeat Aurangzeb's troops, and establishes Maratha Empire.</td>
</tr>
<tr>
<td>1675</td>
<td></td>
<td>Guru Tegh Bahadur, the ninth Guru of Sikhs is executed in Delhi by the order of Aurangzeb for his support for the Kashmiri Hindus to practice their religion. Guru Gobind Singh becomes tenth Guru of Sikhs.</td>
</tr>
<tr>
<td>1680</td>
<td>3 April</td>
<td>Shivaji dies of fever at Raigad.</td>
</tr>
<tr>
<td></td>
<td>20 July</td>
<td>Sambhaji becomes 2nd Chhatrapati of the Maratha Empire</td>
</tr>
<tr>
<td>1681</td>
<td></td>
<td>Aurangzeb invades the Deccan</td>
</tr>
<tr>
<td>1689</td>
<td>11 March</td>
<td>Sambhaji dies.</td>
</tr>
<tr>
<td>1696</td>
<td>20 November</td>
<td>Danish India (to 1869)</td>
</tr>
<tr>
<td>1699</td>
<td>3 October</td>
<td>Guru Gobind Singh, the 10th Guru of Sikhs creates Khalsa, the saint-soldier at Anandpur Sahib, Punjab.</td>
</tr>
<tr>
<td>1700</td>
<td>3 March</td>
<td>Rajaram I dies</td>
</tr>
</tbody>
</table>
18th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1705</td>
<td></td>
<td>Mughal army arrested for the act [clarification needed]</td>
</tr>
<tr>
<td>1707</td>
<td>3 March</td>
<td>Death of Aurangzeb the mughal monarch.</td>
</tr>
<tr>
<td>1708</td>
<td>7 October</td>
<td>Guru Granth Sahib becomes Guru of Sikhs.</td>
</tr>
<tr>
<td>1721</td>
<td>March –</td>
<td>Attingal Outbreak takes place</td>
</tr>
<tr>
<td></td>
<td>October</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13–14</td>
<td>Madras cyclone occurs</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td></td>
</tr>
<tr>
<td>1720</td>
<td></td>
<td>Bajirao I appointed by Shahu Maharaj as Peshwa (prime minister) who later will expand the Maratha empire.</td>
</tr>
<tr>
<td>1756</td>
<td></td>
<td>Black Hole of Calcutta infamous incident where soldiers of East India Company were held hostage in tortuous conditions, later served as a precedent for the Battle of Plassey</td>
</tr>
<tr>
<td>1757</td>
<td>23 June</td>
<td>Battle of Plassey</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Company rule in India (to 1858)</td>
</tr>
<tr>
<td>1758</td>
<td></td>
<td>Third carnatic war</td>
</tr>
<tr>
<td>1759</td>
<td></td>
<td>French India (to 1954)</td>
</tr>
<tr>
<td>1760</td>
<td></td>
<td>Marathas comprehensively defeat the Nizam. Maratha Empire reaches its zenith.</td>
</tr>
<tr>
<td>1761</td>
<td></td>
<td>The Marathas are routed in the Third Battle of Panipat on 14 January 1761, by the Afghans led by Ahmad Shah Durrani, an ethnic Pashtun, also known as Ahmad Shah Abdali. The battle is considered one of the largest battles fought in the 18th century.</td>
</tr>
<tr>
<td>1764</td>
<td>22 October</td>
<td>Battle of Buxar (British victory against allied Mughal, Bengal and Oudh forces)</td>
</tr>
<tr>
<td>1765</td>
<td>12 August</td>
<td>Princely states (to 15 August 1947)</td>
</tr>
<tr>
<td>1767</td>
<td></td>
<td>First Anglo-Mysore War begins, in which Haidar Ali of Mysore defeats the combined armies of the East India Company, the Marathas and the Nizam of Hyderabad.</td>
</tr>
<tr>
<td>1771</td>
<td></td>
<td>Marathas re-captures Delhi and parts of North India.</td>
</tr>
<tr>
<td>1772</td>
<td>22 May</td>
<td>Ram Mohan Roy Born (to 1833)</td>
</tr>
<tr>
<td>1773</td>
<td></td>
<td>Narayanrao Peshwa is murdered by his uncle Raghunathrao's wife in front of Raghunathrao. Regulating Act of 1773 Warren Hastings appointed as first Governor-General of Bengal</td>
</tr>
<tr>
<td>1774</td>
<td></td>
<td>Chief Justice of the Maratha Empire, Ram Shastri passes death sentence against the ruling Peshwa Raghunathrao for murdering his nephew.</td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
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</tr>
<tr>
<td>1775</td>
<td></td>
<td>First Anglo-Maratha War</td>
</tr>
<tr>
<td>1779</td>
<td></td>
<td>Maratha sardar Mahadji Shinde routs the East India Company army at the Battle of Wadgaon. War ends with the restoration of status quo as per Treaty of Salbai.</td>
</tr>
<tr>
<td>1780</td>
<td></td>
<td>Second Anglo-Mysore War begins.</td>
</tr>
<tr>
<td>1784</td>
<td></td>
<td>Second Anglo-Mysore War ends with the Treaty of Mangalore.</td>
</tr>
<tr>
<td>1786</td>
<td></td>
<td>District collectors in Bengal were made responsible for settling the revenue and collecting it.</td>
</tr>
<tr>
<td>1790</td>
<td></td>
<td>The Marathas under Holkar and General de Boigne defeat the Rajputs of Jaipur and Mughals at the Battle of Patan, where 3000+ Rajput cavalry is killed and the entire Mughal unit vanquished. The defeat crushes Rajput hope of independence from external influence.</td>
</tr>
<tr>
<td>1792</td>
<td></td>
<td>Third Anglo-Mysore War ends. [1793] [Birth of Rani Rashmoni, one of the pioneers of the renaissance in Bengal]</td>
</tr>
<tr>
<td>1795</td>
<td>13 August</td>
<td>Death of Ahilyabai Holkar</td>
</tr>
<tr>
<td>1796</td>
<td></td>
<td>Ching-Thang Khomba moves Manipur’s capital to Kangla</td>
</tr>
<tr>
<td>1798</td>
<td></td>
<td>Fourth Anglo-Mysore War begins.</td>
</tr>
<tr>
<td>1799</td>
<td></td>
<td>Fourth Anglo-Mysore War ends with the death of Tipu Sultan, the victory of the East India Company, and the restoration of their ally, the Wodeyar dynasty of Mysore. Polygar War</td>
</tr>
<tr>
<td>1800</td>
<td>13 March</td>
<td>Death of Nana Fadnavis</td>
</tr>
</tbody>
</table>

19th century

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1801</td>
<td>12 April</td>
<td>Maharaja Ranjit Singh establishes Khalsa rule of Punjab from Lahore. Khalsa army liberates Kashmiri Pundits and invades Afghanistan through the Khyber Pass.</td>
</tr>
<tr>
<td>1803</td>
<td></td>
<td>The Second Anglo-Maratha War begins.</td>
</tr>
<tr>
<td>1805</td>
<td>17 December</td>
<td>The Second Anglo-Maratha War ends.</td>
</tr>
<tr>
<td>1806</td>
<td>10 July</td>
<td>Vellore Mutiny</td>
</tr>
<tr>
<td>1809</td>
<td>25 April</td>
<td>The East India Company signs the first Treaty of Amritsar with Ranjit Singh.</td>
</tr>
<tr>
<td>1811</td>
<td>28 October</td>
<td>The death of Yashwantrao Holkar</td>
</tr>
<tr>
<td>1814</td>
<td>15 January</td>
<td>&quot;Atmiya Sabha&quot; is established by Raja Ram Mohan Roy.</td>
</tr>
<tr>
<td>1817</td>
<td>3 June, 20 January</td>
<td>The Third Anglo-Maratha War begins.</td>
</tr>
<tr>
<td>Year</td>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>------</td>
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<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>1818</td>
<td>31 December</td>
<td>Establishment of Hindu College (Presidency College, now Presidency University, Kolkata)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>The Third Anglo-Maratha War ends with the defeat of Bajirao II and the end of the Maratha Empire, leaving the East India Company with control of almost the whole of India.</td>
</tr>
<tr>
<td>1820</td>
<td>31 December</td>
<td>Ishwar Chandra Vidyasagar is born (to 1891).</td>
</tr>
<tr>
<td>1823</td>
<td>5 March</td>
<td>Anglo-Burmese Wars (to 1826)</td>
</tr>
<tr>
<td>1824</td>
<td>12 February</td>
<td>Dayananda Saraswati is born (to 1883)</td>
</tr>
<tr>
<td>1826</td>
<td>4 January</td>
<td>British rule in Burma (to 1947)</td>
</tr>
<tr>
<td>1827</td>
<td>11 April</td>
<td>Jyotirao Phule is born (to 1890)</td>
</tr>
<tr>
<td>1828</td>
<td>19 November</td>
<td>Rani of Jhansi Laxmi bai was born (to 1858)</td>
</tr>
<tr>
<td>1829</td>
<td></td>
<td>Kol uprising</td>
</tr>
<tr>
<td>1836</td>
<td>18 February</td>
<td>Sri Ramakrishna Paramhansa is born (to 1886)</td>
</tr>
<tr>
<td>1839</td>
<td></td>
<td>First Anglo-Afghan War</td>
</tr>
<tr>
<td>1845</td>
<td>13 January</td>
<td>First Anglo-Sikh Wars (to 1849)</td>
</tr>
<tr>
<td></td>
<td>4 November</td>
<td>Vasudev Balwant Phadke is born (to 1883)</td>
</tr>
<tr>
<td>1853</td>
<td>1 April</td>
<td>The Post Service started.</td>
</tr>
<tr>
<td>1853</td>
<td>16 April</td>
<td>The first railway is established between Bombay and Thane.</td>
</tr>
<tr>
<td>1855</td>
<td>30 June</td>
<td>Santhal rebellion</td>
</tr>
<tr>
<td>1856</td>
<td>25 July</td>
<td>Hindu Widows' Remarriage Act, 1856</td>
</tr>
<tr>
<td></td>
<td>23 July</td>
<td>Bal Gangadhar Tilak is born (to 1920)</td>
</tr>
<tr>
<td></td>
<td>20 August</td>
<td>Narayana Guru is born (to 1928)</td>
</tr>
<tr>
<td>1857</td>
<td>10 May</td>
<td>British victory in Indian Rebellion of 1857.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Last Mughal Emperor Bahadur Shah Zafar was deposed by British East India Company and India transferred to British Crown.</td>
</tr>
<tr>
<td></td>
<td>18 July, 24 January</td>
<td>India's first three universities, the University of Mumbai, the University of Madras and the University of Calcutta, are established.</td>
</tr>
<tr>
<td>1858</td>
<td>18 June 1858</td>
<td>Rani of Jhansi, Rani Lakshmibai died</td>
</tr>
<tr>
<td></td>
<td>1 November</td>
<td>British Raj (to 1947)</td>
</tr>
<tr>
<td></td>
<td>7 November</td>
<td>Bipin Chandra Pal is born (to 1932)</td>
</tr>
<tr>
<td>1859</td>
<td>18 April</td>
<td>Death of Tatya Tope</td>
</tr>
<tr>
<td>Year</td>
<td>Month</td>
<td>Event</td>
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<tr>
<td>------</td>
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</tr>
<tr>
<td>1861</td>
<td>7 May</td>
<td>Rabindranath Tagore is born.</td>
</tr>
<tr>
<td>1862</td>
<td></td>
<td>The high courts of Calcutta, Madras, and Bombay are established.</td>
</tr>
<tr>
<td>1863</td>
<td>12 January</td>
<td>Swami Vivekanand is born (to 1902)</td>
</tr>
<tr>
<td>1865</td>
<td>28 January</td>
<td>Lala Lajpat Rai is born (to 1928)</td>
</tr>
<tr>
<td>1867</td>
<td>31 March</td>
<td>&quot;Prarthana Samaj&quot; established earlier known as &quot;Atmiya Sabha&quot;, &quot;Tahzeeb-ul-Akňlaq&quot; was started</td>
</tr>
<tr>
<td>1869</td>
<td>2 October</td>
<td>Mahatma Gandhi is born (to 30 January 1948)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Thakkar Bapa is born (to 1951)</td>
</tr>
<tr>
<td>1873</td>
<td>24 September</td>
<td>Jyotirao Phule establishes the &quot;Satyashodhak Samaj&quot; society.</td>
</tr>
<tr>
<td>1875</td>
<td>10 April</td>
<td>&quot;Arya Samaj&quot; is established.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Aligarh Muslim University</td>
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<tr>
<td></td>
<td></td>
<td>Deccan Riots</td>
</tr>
<tr>
<td>1876</td>
<td>25 December</td>
<td>Muhammad Ali Jinnah was born (1876–1948)</td>
</tr>
<tr>
<td>1877</td>
<td>1 January</td>
<td>The first Delhi Durbar</td>
</tr>
<tr>
<td>1883</td>
<td>30 September</td>
<td>Maharishi Dayanand saraswati die</td>
</tr>
<tr>
<td>1885</td>
<td>28 December</td>
<td>The Indian National Congress is established</td>
</tr>
<tr>
<td>1889</td>
<td>14 November</td>
<td>Jawaharlal Nehru is born (to 1964).</td>
</tr>
<tr>
<td>1889</td>
<td>3 December</td>
<td>Khudiram Bose is born (to 1908).</td>
</tr>
<tr>
<td>1891</td>
<td>14 April</td>
<td>B. R. Ambedkar is born (to 1956).</td>
</tr>
<tr>
<td>1891</td>
<td>31 March</td>
<td>Anglo-Manipur War.</td>
</tr>
<tr>
<td>1895</td>
<td>11 May</td>
<td>Jiddu Krishnamurti is born (to 17 February 1986).</td>
</tr>
<tr>
<td>1897</td>
<td>23 January</td>
<td>Subhas Chandra Bose is born (to 1945); the first fingerprint bureau of India is established in Calcutta.</td>
</tr>
<tr>
<td>1899</td>
<td>11 June</td>
<td>Ramprasad Bismil was born</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;Mitra Mela&quot; is established by V.D. Savarkar, plague commission</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Chapekar brother {assassination of W.C. Rand}</td>
</tr>
</tbody>
</table>

**20th Century**
<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1902</td>
<td>Anushilan Samiti, revolutionary association formed.</td>
<td></td>
</tr>
<tr>
<td>1903</td>
<td>11 December</td>
<td>British Expedition to Tibet</td>
</tr>
<tr>
<td></td>
<td>1 January</td>
<td>Delhi Durbar Second Time.</td>
</tr>
<tr>
<td>1904</td>
<td>5 November</td>
<td>University Act</td>
</tr>
<tr>
<td>1905</td>
<td>16 October</td>
<td>Partition of Bengal</td>
</tr>
<tr>
<td>1906</td>
<td>30 December</td>
<td>Muslim League formed in Dacca.</td>
</tr>
<tr>
<td>1907</td>
<td>Surat Split</td>
<td></td>
</tr>
<tr>
<td>1908</td>
<td>Alipore bomb case</td>
<td></td>
</tr>
<tr>
<td>1909</td>
<td>Morley-Minto Reforms</td>
<td></td>
</tr>
<tr>
<td>1911</td>
<td>Cancellation of Partition of Bengal</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Delhi Durbar Third Time</td>
<td></td>
</tr>
<tr>
<td>1911</td>
<td>12 December</td>
<td>The British government moves the capital from Calcutta to Delhi.</td>
</tr>
<tr>
<td>1912</td>
<td>Delhi conspiracy case</td>
<td></td>
</tr>
<tr>
<td>1913</td>
<td>Gadar Party formed</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rabindranath Tagore won Nobel Prize in Literature</td>
<td></td>
</tr>
<tr>
<td>1914</td>
<td>Hindu–German Conspiracy</td>
<td></td>
</tr>
<tr>
<td>1915</td>
<td>Ghadar conspiracy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Provisional Government of India formed in Kabul.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mahatma Gandhi returns to India.</td>
<td></td>
</tr>
<tr>
<td>1916</td>
<td>Lucknow Pact</td>
<td></td>
</tr>
<tr>
<td>1917</td>
<td>Champaran Satyagraha</td>
<td></td>
</tr>
<tr>
<td>1918</td>
<td>Kheda Satyagraha</td>
<td></td>
</tr>
<tr>
<td>1919</td>
<td>Jallianwala Bagh massacre</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Montagu–Chelmsford Reforms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rowlatt Act is passed</td>
<td></td>
</tr>
<tr>
<td>1920</td>
<td>Non-cooperation movement Khilafat Movement</td>
<td></td>
</tr>
<tr>
<td>1922</td>
<td>5 February</td>
<td>Chauri Chaura incident</td>
</tr>
<tr>
<td>1924</td>
<td>The Hindustan Socialist Republican Association is formed.</td>
<td></td>
</tr>
<tr>
<td>1925</td>
<td>9 August</td>
<td>Kakori conspiracy</td>
</tr>
<tr>
<td>1927</td>
<td>20 March</td>
<td>Mahad Satyagraha</td>
</tr>
<tr>
<td></td>
<td>November</td>
<td>Simon Commission</td>
</tr>
<tr>
<td>1928</td>
<td>Bardoli Satyagraha</td>
<td></td>
</tr>
<tr>
<td>1929</td>
<td>Central Assembly bombed by Bhagat Singh and Batukeshwar Dutt.</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
<td></td>
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<tr>
<td>------</td>
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</tr>
<tr>
<td>1930</td>
<td>Purna Swaraj resolution. Salt Satyagraha, the civil disobedience movement, begins with the Dandi march. The first Round Table Conferences (India)</td>
<td></td>
</tr>
<tr>
<td>1931</td>
<td>March</td>
<td>Gandhi–Irwin Pact</td>
</tr>
<tr>
<td></td>
<td>23 March</td>
<td>Bhagat Singh, Rajguru and Sukhdev martyred</td>
</tr>
<tr>
<td></td>
<td>September–December</td>
<td>The second Round Table Conferences (India)</td>
</tr>
<tr>
<td>1932</td>
<td>24 September</td>
<td>Poona Pact</td>
</tr>
<tr>
<td></td>
<td>16 August</td>
<td>Communal Award</td>
</tr>
<tr>
<td></td>
<td>November–December</td>
<td>The third Round Table Conferences (India)</td>
</tr>
<tr>
<td>1935</td>
<td>August</td>
<td>Government of India Act 1935</td>
</tr>
<tr>
<td>1937</td>
<td></td>
<td>1937 Indian provincial elections</td>
</tr>
<tr>
<td>1939</td>
<td></td>
<td>The All India Forward Bloc established by Subhas Chandra Bose</td>
</tr>
<tr>
<td>1940</td>
<td>23 March</td>
<td>Lahore Resolution</td>
</tr>
<tr>
<td></td>
<td>8 August</td>
<td>August offer 1940</td>
</tr>
<tr>
<td>1942</td>
<td>late March</td>
<td>Cripps' mission</td>
</tr>
<tr>
<td></td>
<td>August</td>
<td>1. Quit India movement 2. The Indian National Army is established by Subhas Chandra Bose.</td>
</tr>
<tr>
<td>1943</td>
<td></td>
<td>Arzi Hukumat-e-Azad Hind, the Provisional Government of Free India is formed by Netaji.</td>
</tr>
<tr>
<td>1944</td>
<td></td>
<td>Subhas Chandra Bose calls Mahatma Gandhi the Father of the Nation.</td>
</tr>
<tr>
<td>1945</td>
<td>18 August</td>
<td>Subhas Chandra Bose death in plane crash at Taiwan. Wavell Plan, Simla Conference</td>
</tr>
<tr>
<td>1946</td>
<td>February</td>
<td>Royal Indian Navy Mutiny</td>
</tr>
<tr>
<td></td>
<td>March</td>
<td>Cabinet Mission</td>
</tr>
<tr>
<td></td>
<td>16 August</td>
<td>Direct Action Day/Great Calcutta Killings</td>
</tr>
<tr>
<td>1948</td>
<td>30 January</td>
<td>Mahatma Gandhi is assassinated by Nathuram Godse. War with Pakistan over disputed territory of Kashmir. Telangana and other princely states are integrated into Indian union.</td>
</tr>
<tr>
<td>1950</td>
<td>26 January</td>
<td>India became a republic.</td>
</tr>
<tr>
<td>1951</td>
<td></td>
<td>Congress Party wins first general elections under leadership of Jawaharlal Nehru (to 1952).</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
<td></td>
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<tr>
<td>------</td>
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<td></td>
</tr>
<tr>
<td>1955</td>
<td>Nationalisation of the Indian insurance sector. Establishment of LIC.</td>
<td></td>
</tr>
</tbody>
</table>
| 1956 | B. R. Ambedkar converted to Buddhism along with 600,000 followers.  
| 6 December | B. R. Ambedkar died. |
| 1962 | War over disputed territory of Kashmir with China.  
| | India seizes Diu, Daman and Goa from Portuguese India. |
| 1964 | 27 May Death of Prime Minister Jawaharlal Nehru.  
| 1965 | 6–23 September Second war with Pakistan over Kashmir. |
| 1966 | 11 January Prime Minister Lal Bahadur Shastri's mysterious death in Tashkant.  
| | Nehru's daughter Indira Gandhi becomes prime minister. |
| 1971 | Third war with Pakistan over creation of Bangladesh, formerly East Pakistan.  
| | Twenty-year treaty of friendship signed with Soviet Union. |
| 1974 | India Smiling Buddha first nuclear device in underground test. |
| 1975 | Indira Gandhi declares a state of emergency after being found guilty of electoral malpractice.  
| | Nearly 1,000 political opponents imprisoned and programme of compulsory birth control introduced. (to 1977) |
| | The Communist party of India comes into power in West Bengal. |
| 1979 | The Janata Party splits. Chaudhary Charan Singh becomes Prime Minister. |
| 1980 | Indira Gandhi returns to power heading the Congress party splinter group, Congress (Indira). |
| 1983 | N. T. Rama Rao NTR's nine-month-old Telugu Desam assumes power in AP becoming a challenger post Loknayak Jayprakash Narayan against Indira Gandhi. |
| 1984 | India won World Cup for the first time, in one day international Cricket led by Kapil Dev.  
| | Troops storm Golden Temple, the Sikhs' most holy shrine, after Jarnail Singh Bhindranwale seeks refuge inside. There are a movement to flush out Sikh separatism and calls for secularism, called Operation Blue Star. "Anti-Sikh Riots 1984".  
| | Indira Gandhi is assassinated by her Sikh bodyguards; her son, Rajiv, takes over.  
| | Many Sikhs were killed due to the assassination of Indira Gandhi. see 1984 anti-Sikh riots. |
| 1987 | India deploys troops for peacekeeping operation in Sri Lanka's ethnic conflict. |
| 1988 | SEBI was established by The Government of India on 12 April 1988 and given statutory powers in 1992 with SEBI Act 1992 being passed by the Indian Parliament. |
| 1989 | Falling public support leads to a Congress defeat in general election.  
| 1989 | The National Front (India), headed by V. P. Singh and led by Janata Dal, is formed and storms into power with outside support from BJP and CPI. |
1990 | Muslim separatist groups begin campaign of violence in Kashmir.
---|---
1991 | Rajiv Gandhi is assassinated by a suicide bomber sympathetic to Sri Lanka's Tamil Tigers.
| An economic reform programme is begun by Prime Minister P.V. Narasimha Rao.
1992 | Babri Mosque in Ayodhya is demolished, triggering widespread Hindu-Muslim violence.
| Over 200 people die in Cuttack in Odisha, after drinking illegally brewed liquor in the 1992 Odisha liquor deaths incident.
1995 July | West Bengal Chief Minister Jyoti Basu made the first call from Kolkata to inaugurate the cellular services in India.
1996 | Congress suffers its worst electoral defeat ever as BJP emerges as the largest single party.
1996 August | The Amarnath Yatra tragedy in which at least 194 pilgrims are reported to have frozen to death in northern Kashmir after being stranded by violent rain and snow storms.
1998 | BJP forms coalition government under Prime Minister Atal Bihari Vajpayee.
| India and Pakistan carry out nuclear tests, leading to widespread international condemnation.
1999 February | Vajpayee makes a historic bus trip to Pakistan to meet Premier Nawaz Sharif and to sign bilateral Lahore peace declaration.
| May | Tension in Kashmir leads to a brief war with Pakistan-backed forces in the icy heights around Kargil in Indian-administered Kashmir.
| October | The Cyclone devastates eastern state of Odisha, leaving at least 10,000 dead.
2000 March | US President Bill Clinton makes a groundbreaking visit to improve ties.
| May | India marks the birth of its billionth citizen.
| November | The states of Jharkhand, Chhattisgarh & Uttrakhand (Uttranchal) were created on 15 November 2000.

**21st century**

<table>
<thead>
<tr>
<th>Year</th>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>26 January</td>
<td>The 7.7 Mw Gujarat earthquake shakes Western India with a maximum Mercalli intensity of X (Extreme), leaving 13,805–20,023 dead and about 166,800 injured.</td>
</tr>
<tr>
<td>July</td>
<td>Vajpayee meets Pakistani President Pervez Musharraf in the first summit between the two neighbours in more than two years. The meeting ends without a breakthrough or even a joint statement because of differences over Kashmir.</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>Vajpayee's BJP party declines his offer to resign over a number of political scandals and the apparent failure of his talks with Pakistani President Musharraf.</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>US lifts sanctions which it imposed against India and Pakistan after they staged nuclear tests in 1998. The move is seen as a reward for their support for the US-led anti-terror campaign.</td>
<td></td>
</tr>
<tr>
<td>Month</td>
<td>Event</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>October</td>
<td>India and Pakistan fire at each other's military posts in the heaviest firing along the dividing line of control in Kashmir for almost a year.</td>
<td></td>
</tr>
<tr>
<td>October</td>
<td>Pakistani forces shelled the village of Arnia about three km (two miles) from the border in the early hours of Monday 6 June, killing five and wounding at least two dozen civilians.</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>Suicide squad attacks parliament in New Delhi, killing several police. The five gunmen die in the assault.</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>India imposes sanctions against Pakistan, to force it to take action against two Kashmir militant groups blamed for the suicide attack on parliament. Pakistan retaliates with similar sanctions, and bans the groups in January.</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>India, Pakistan mass troops on common border amid mounting fears of a looming war.</td>
<td></td>
</tr>
<tr>
<td>2002</td>
<td>War of words between Indian and Pakistani leaders intensifies. Actual war seems imminent.</td>
<td></td>
</tr>
<tr>
<td>January</td>
<td>India successfully test-fires a nuclear-capable ballistic missile – the Agni – off its eastern coast.</td>
<td></td>
</tr>
<tr>
<td>February</td>
<td>Inter-religious bloodshed breaks out after 59 Hindu pilgrims returning from Ayodhya are killed in a train fire in Godhra, Gujarat. More than 1,000 people, die in subsequent riots. (Police and officials blamed the fire on a Muslim mob; a 2005 government investigation said it was an accident, though later court and SIT report held Muslim mob responsible.)</td>
<td></td>
</tr>
<tr>
<td>May</td>
<td>Pakistan test-fires three medium-range surface-to-surface Ghauri missiles, which are capable of carrying nuclear warheads.</td>
<td></td>
</tr>
<tr>
<td>June</td>
<td>UK, US urge their citizens to leave India and Pakistan, while maintaining diplomatic offensive to avert war.</td>
<td></td>
</tr>
<tr>
<td>July</td>
<td>Retired scientist and architect of India's missile programme A.P.J. Abdul Kalam is elected president.</td>
<td></td>
</tr>
<tr>
<td>2003</td>
<td>August</td>
<td>At least 50 people are killed in two simultaneous bomb blasts in Bombay.</td>
</tr>
<tr>
<td>November</td>
<td>India matches Pakistan's declaration of a Kashmir ceasefire.</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>India, Pakistan agree to resume direct air links and to allow overflights.</td>
<td></td>
</tr>
<tr>
<td>2004</td>
<td>January</td>
<td>Groundbreaking meeting is held between government and moderate Kashmir separatists.</td>
</tr>
<tr>
<td>May</td>
<td>Surprise victory for Congress Party in general elections. Manmohan Singh is sworn in as prime minister.</td>
<td></td>
</tr>
<tr>
<td>September</td>
<td>India, along with Brazil, Germany and Japan, launches an application for a permanent seat on the UN Security Council.</td>
<td></td>
</tr>
<tr>
<td>November</td>
<td>India begins to withdraw some of its troops from Kashmir.</td>
<td></td>
</tr>
<tr>
<td>December</td>
<td>Thousands are killed when tsunami, caused by the 2004 Indian Ocean earthquake off the Indonesian coast, devastate coastal communities in the south and in the Andaman and Nicobar Islands.</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td>July</td>
<td>More than 1,000 people are killed in floods and landslides caused by monsoon rains in</td>
</tr>
</tbody>
</table>
Mumbai (Bombay) and Maharashtra region.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 October</td>
<td>The 7.6 ( M_w ) Kashmir earthquake strikes with a maximum Mercalli intensity of VIII (Severe), leaving 86,000–87,351 people dead, 69,000–75,266 injured, and 2.8 million homeless.</td>
</tr>
<tr>
<td>2006</td>
<td>February</td>
</tr>
<tr>
<td></td>
<td>India's largest-ever rural jobs scheme is launched, aimed at lifting around 60 million families out of poverty.</td>
</tr>
<tr>
<td></td>
<td>March</td>
</tr>
<tr>
<td></td>
<td>US and India sign a nuclear agreement during a visit by US President George W. Bush. The US gives India access to civilian nuclear technology while India agrees to greater scrutiny for its nuclear programme.</td>
</tr>
<tr>
<td>2007</td>
<td>February</td>
</tr>
<tr>
<td></td>
<td>India and Pakistan sign an agreement aimed at reducing the risk of accidental nuclear war.</td>
</tr>
<tr>
<td>18 February</td>
<td>68 passengers, most of them Pakistanis, are killed by bomb blasts and a blaze on a train travelling from New Delhi to the Pakistani city of Lahore.</td>
</tr>
<tr>
<td>March</td>
<td>Maoist rebels in Chhattisgarh state kill more than 50 policemen in a dawn attack.</td>
</tr>
<tr>
<td>April</td>
<td>India's first commercial space rocket is launched, carrying an Italian satellite.</td>
</tr>
<tr>
<td>May</td>
<td>Government announces its strongest economic growth figures for 20 years – 9.4% in the year to March.</td>
</tr>
<tr>
<td>May</td>
<td>At least nine people are killed in a bomb explosion at the main mosque in Hyderabad. Several others are killed in subsequent rioting.</td>
</tr>
<tr>
<td>July</td>
<td>India says the number of its people with HIV or AIDS is about half of earlier official tallies. Health ministry figures put the total at between 2 million and 3.1 million cases, compared with previous estimates of more than 5 million.</td>
</tr>
<tr>
<td>July</td>
<td>Pratibha Patil becomes first woman to be elected president of India.</td>
</tr>
<tr>
<td>2008</td>
<td>July</td>
</tr>
<tr>
<td></td>
<td>Series of explosions kills 49 in Ahmedabad, in Gujarat state. The little-known terrorist group Indian Mujahideen claims responsibility.</td>
</tr>
<tr>
<td>October</td>
<td>Following approval by the US Congress, President George W. Bush signs into law a nuclear deal with India, which ends a three-decade ban on US nuclear trade with Delhi.</td>
</tr>
<tr>
<td>October</td>
<td>India successfully launches its first mission to the moon, the unmanned lunar probe Chandrayaan-1.</td>
</tr>
<tr>
<td>November</td>
<td>The 2008 Mumbai attacks (often called the 26/11 attacks) kill 174 people, including 9 of the 10 terrorists from Lashkar-e-Taiba, an Islamic terrorist organisation based in Pakistan. India decides not to attack Pakistan in retaliation.</td>
</tr>
<tr>
<td>December</td>
<td>India announces &quot;pause&quot; in peace process with Pakistan. Indian cricket team cancels planned tour of Pakistan.</td>
</tr>
<tr>
<td>2009</td>
<td>February</td>
</tr>
<tr>
<td></td>
<td>India and Russia sign deals worth $700 million, according to which Moscow will supply Uranium to Delhi.</td>
</tr>
<tr>
<td>May</td>
<td>Resounding general election victory gives governing Congress-led alliance of PM Manmohan Singh an enhanced position in parliament, only 11 seats short of an absolute majority.</td>
</tr>
<tr>
<td>Date</td>
<td>Event Description</td>
</tr>
<tr>
<td>----------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>July 2010</td>
<td>Delhi court decriminalizes gay sex</td>
</tr>
<tr>
<td>February 2011</td>
<td>16 people are killed in a bomb explosion at German Bakery in the city of Pune, Maharashtra.</td>
</tr>
<tr>
<td>April 2011</td>
<td>India wins cricket world cup after 28 years under the captaincy of Mahendra Singh Dhoni.</td>
</tr>
<tr>
<td>May 2011</td>
<td>After 34 years of Left Front Government, Trinamool Congress and Congress alliance come to power in West Bengal.</td>
</tr>
<tr>
<td>July 2012</td>
<td>Pranab Mukherjee, the former Finance Minister is elected as the 13th president of India.</td>
</tr>
<tr>
<td>12 February 2013</td>
<td>Indian helicopter bribery scandal comes to light.</td>
</tr>
<tr>
<td>21 February 2013</td>
<td>Terror attacks in Hyderabad in Dilsukhnagar area.</td>
</tr>
<tr>
<td>5 November 2013</td>
<td>Mars Orbiter Mission, is successfully launched into Mars orbit by the Indian Space Research Organisation (ISRO).</td>
</tr>
<tr>
<td>16 May 2014</td>
<td>Narendra Modi elected as prime minister of India, Congress was routed in the general elections.</td>
</tr>
<tr>
<td>2 June 2014</td>
<td>Telangana, The state of Telangana was officially formed on 2 June 2014.</td>
</tr>
<tr>
<td>2–5 January 2016</td>
<td>Terror Attacks on Pathankot Air Base.</td>
</tr>
<tr>
<td>27 June 2016</td>
<td>India becomes a member of Missile Technology Control Regime.</td>
</tr>
<tr>
<td>27 September 2016</td>
<td>India launches its first space laboratory Astrosat in its biggest project since its Mars orbiter mission in 2014.</td>
</tr>
<tr>
<td>23 September 2016</td>
<td>India signs a billion-dollar defence deal with France to buy 36 Rafale fighter jets.</td>
</tr>
<tr>
<td>8 November 2016</td>
<td>In a surprise announcement, the government withdraws high denomination notes from circulation causing chaotic scenes at banks across the country as customers try to exchange old notes.</td>
</tr>
<tr>
<td>30 June 2017</td>
<td>The Goods and Services Tax (GST) launched, the biggest tax reform in history of India.</td>
</tr>
<tr>
<td>14 February 2019</td>
<td>A convoy of vehicles carrying Central Reserve Police Force (CRPF) personnel on the Jammu Srinagar National Highway was attacked by a vehicle-borne suicide bomber in the Pulwama district, Jammu and Kashmir, India.</td>
</tr>
<tr>
<td>26 February 2019</td>
<td>The 2019 Balakot airstrike was conducted by India, when Indian warplanes crossed the de facto border in the disputed region of Kashmir, and dropped bombs in the vicinity of the town of Balakot in Khyber Pakhtunkhwa province in Pakistan.</td>
</tr>
<tr>
<td>27 February 2019</td>
<td>The 2019 Balakot strike from Indian side was given a reply named &quot;Swift Retort&quot;. After a dog fight between Pakistani and Indian Fighter Pilots. Indian Wing Commander Abhinandan Varthaman was captured by the Pakistani side. However acting to the pressure of various global leaders and bound by the Vienna Convention, Pakistan was Forced to release the</td>
</tr>
</tbody>
</table>
Indian Pilot with all due respect.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 August</td>
<td>The state of Jammu and Kashmir was divided into two separate union territories known as Jammu Kashmir and Ladakh by Scrapping Article 370 of Indian constitution.</td>
</tr>
<tr>
<td>11 December</td>
<td>The Citizenship (Amendment) Act, 2019 was passed by the Parliament of India on 11 December 2019. It amended the Citizenship Act of 1955 by providing a path to Indian citizenship for members of Hindu, Sikh, Buddhist, Jain, Parsi, and Christian religious minorities, who had fled persecution from Pakistan, Bangladesh and Afghanistan before December 2014.</td>
</tr>
<tr>
<td>2020</td>
<td>The first ever COVID-19 case of the country was reported in Kerala's Thrissur district.</td>
</tr>
</tbody>
</table>

**Timeline of Buddhism**

**6th–5th century BCE**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 563 BCE</td>
<td>The Birth of Siddhartha Gautama. The approximate date of Gautama Buddha's birth and death are uncertain. Most historians in the early 20th century dated his lifetime as circa 563 BCE to 483 BCE. More recently his death is dated later, between 411 and 400 BCE, while at a symposium on this question held in 1988, the majority of those who presented definite opinions gave dates within 20 years either side of 400 BCE for the Buddha's death.</td>
</tr>
<tr>
<td>or c. 480 BCE</td>
<td></td>
</tr>
<tr>
<td>c. 413–345 BCE</td>
<td>Shishunaga, a minister of the ruling Hiranyaka dynasty of Magadha, is placed on the throne and begins the Shishunaga dynasty, after the sitting king is deposed by the people.</td>
</tr>
</tbody>
</table>

**4th century BCE**

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>383 BCE or c. 330 BCE</td>
<td>The Second Buddhist council is convened by Kalasoka of the Shishunaga dynasty and held in Vaishali. The Sangha divides into the Sthaviravadin and the Mahasanghikas led by the monk Mahādeva, primarily over the question of addition or subtraction of rules from the Vinaya.</td>
</tr>
<tr>
<td>345–321 BCE</td>
<td>The Nanda Empire briefly predominates in Magadha over the Shishunagas.</td>
</tr>
<tr>
<td>326 BCE</td>
<td>Alexander the Great reaches North West India. The Indo-Greek kingdoms that arise in the aftermath have a large influence upon the development of Buddhism.</td>
</tr>
<tr>
<td>c. 324 BCE</td>
<td>Pyrrho, a philosopher in Alexander the Great's court, learns elements of Buddhist philosophy in India.</td>
</tr>
</tbody>
</table>
He incorporates parts of Buddhism, most notably the three marks of existence, into his new philosophy of Pyrrhonism which he introduces into Hellenistic philosophy.

The reign of Chandragupta Maurya, grandfather of Asoka, who subdues the Nanda Dynasty by c. 320 BCE, and gradually conquers much of northern India.

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 250 BCE</td>
<td>Third Buddhist council, convened by Ashoka and chaired by Moggaliputta-Tissa, compiles the <em>Kathavatthu</em> to refute the heretical views and theories held by some Buddhist sects. Edicts of Ashoka in the Maurya Empire in support of Buddhism.</td>
</tr>
<tr>
<td>c. 250 BCE</td>
<td>Ashoka sends various Buddhist missionaries to faraway countries, as far as China, mainland Southeast Asia and the Malay kingdoms in the east and the Hellenistic kingdoms in the west, in order to make Buddhism known to them.</td>
</tr>
<tr>
<td>c. 250 BCE</td>
<td>First-fully developed examples of Kharosthi script in the inscriptions at Shahbazgarhi and Mānehrā in Gandhara.</td>
</tr>
<tr>
<td>c. 250 BCE</td>
<td>Indian traders regularly visit ports in the Arabian Peninsula, explaining the prevalence of place names in the region with Indian or Buddhist origin; e.g., <em>bahar</em> (from Sanskrit <em>vihara</em> (a Buddhist monastery). Ashokan emissary monks bring Buddhism to Suvarnabhumi, the location of which is disputed. The <em>Dipavamsa</em> says it was a Mon seafaring settlement in present-day Burma.</td>
</tr>
<tr>
<td>c. 220 BCE</td>
<td>Theravada is officially introduced to Sri Lanka by the Mahinda, son of Ashoka, during the reign of Devanampiya Tissa of Anuradhapura.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>185 BCE</td>
<td>General Pushyamitra Shunga overthrows the Maurya Empire and establishes the Shunga Empire, apparently starting a wave of persecution against Buddhism.</td>
</tr>
<tr>
<td>180 BCE</td>
<td>Demetrius I of Bactria invades India as far as Pataliputra and establishes the Indo-Greek Kingdom (180–10 BCE), under which Buddhism flourishes.</td>
</tr>
<tr>
<td>165–130 BCE</td>
<td>Reign of the Indo-Greek king Menander I, who converts to Buddhism under the sage Nagasena according to the account of the <em>Milinda Panha</em>.</td>
</tr>
<tr>
<td>121 BCE</td>
<td>The Chinese Emperor Han Wudi (156–87 BCE) receives two golden statues of the Buddha, according to inscriptions in the Mogao Caves, Dunhuang.</td>
</tr>
</tbody>
</table>
## 1st century BCE

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 55 BCE</td>
<td>The Indo-Greek governor Theodorus enshrines relics of the Buddha, dedicating them to the deified &quot;Lord Shakyamuni.&quot;</td>
</tr>
<tr>
<td>29 BCE</td>
<td>According to the Sinhalese chronicles, the Pali Canon is written down in the reign of King Vattagamini (29–17 BCE)</td>
</tr>
<tr>
<td>2 BCE</td>
<td>The Hou Hanshu records the visit in 2 BCE of Yuezhi envoys to the Chinese capital, who give oral teachings on Buddhist sutras.</td>
</tr>
</tbody>
</table>

## 1st century

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>67</td>
<td>Liu Ying's sponsorship of Buddhism is the first documented case of Buddhist practices in China.</td>
</tr>
<tr>
<td>67</td>
<td>Buddhism comes to China with the two monks Kasyapa and Dharmaraksha.</td>
</tr>
<tr>
<td>68</td>
<td>Buddhism is officially established in China with the founding of the White Horse Temple.</td>
</tr>
<tr>
<td>78</td>
<td>Ban Chao, a Chinese General, subdues the Buddhist Kingdom of Khotan.</td>
</tr>
<tr>
<td>c. 78–101</td>
<td>According to Mahayana tradition, the Fourth Buddhist council takes place under Kushana king Kanishka's reign, near Jalandar, India.</td>
</tr>
</tbody>
</table>

## 2nd century

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>116</td>
<td>The Kushans, under Kanishka, establish a kingdom centered on Kashgar, also taking control of Khotan and Yarkand in the Tarim Basin.</td>
</tr>
<tr>
<td>148</td>
<td>An Shigao, a Parthian prince and Buddhist monk, arrives in China and proceeds to make the first translations of Theravada texts into Chinese.</td>
</tr>
<tr>
<td>c. 150–250</td>
<td>Indian and Central Asian Buddhists travel to Vietnam.</td>
</tr>
<tr>
<td>178</td>
<td>The Kushan monk Lokaksema travels to the Chinese capital of Loyang and becomes the first known translator of Mahayana texts into Chinese.</td>
</tr>
</tbody>
</table>

## 3rd century

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 250</td>
<td>Use of Kharoṣṭhī script in Gandhara stops.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>c. 250–350</td>
<td>Kharoṣṭhī script is used in the southern Silk Road cities of Khotan and Niya.</td>
</tr>
<tr>
<td>296</td>
<td>The earliest surviving Chinese Buddhist manuscript dates from this year (<em>Zhu Fo Yao Ji Jing</em>, discovered in Dalian, late 2005).</td>
</tr>
</tbody>
</table>

### 4th century

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>320–467</td>
<td>The University at Nalanda grows to support 3,000–10,000 monks.</td>
</tr>
<tr>
<td>372</td>
<td>The monk Sundo (順道, or Shundao in Chinese) was sent by Fu Jian (337–385) (苻堅) of Former Qin to the court of the King Sosurim of Goguryeo, in modern day Korea. Subsequently, paper making was established in Korea.</td>
</tr>
<tr>
<td>384</td>
<td>The Indian monk Marananta arrived in Baekje, in modern day Korea, and the royal family received the strain of Buddhism he brought. King Asin of Baekje proclaimed, &quot;people should believe in Buddhism and seek happiness.&quot;</td>
</tr>
<tr>
<td>399–414</td>
<td>Fa Xian travels from China to India, then returns to translate Buddhist works into Chinese.</td>
</tr>
</tbody>
</table>

### 5th century

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 5th century</td>
<td>The kingdom of Funan (centered in modern Cambodia) begins to advocate Buddhism in a departure from Hinduism. Earliest evidence of Buddhism in Myanmar (Pali inscriptions). Earliest evidence of Buddhism in Indonesian (statues). Earliest reinterpretations of Pali texts. The stupa at Dambulla (Sri Lanka) is constructed.</td>
</tr>
<tr>
<td>402</td>
<td>At the request of Yao Xing, Kumarajiva travels to Chang'an and translates many Buddhist texts into Chinese.</td>
</tr>
<tr>
<td>403</td>
<td>In China, Hui Yuan argues that Buddhist monks should be exempt from bowing to the emperor.</td>
</tr>
<tr>
<td>405</td>
<td>Yao Xing honours Kumarajiva.</td>
</tr>
<tr>
<td>425</td>
<td>Buddhism reaches Sumatra.</td>
</tr>
<tr>
<td>464</td>
<td>Buddhhabhadra reaches China to preach Buddhism.</td>
</tr>
<tr>
<td>485</td>
<td>Five monks from Gandhara travel to the country of Fusang (Japan, or possibly the Americas), where they introduce Buddhism.</td>
</tr>
<tr>
<td>495</td>
<td>The Shaolin temple is built in the name of Buddhhabhadra, by edict of emperor Wei Xiao Wen.</td>
</tr>
</tbody>
</table>
### 6th century

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>527</td>
<td>Bodhidharma settles into the Shaolin monastery in Henan province of China.</td>
</tr>
<tr>
<td>531–579</td>
<td>Reign of the Zoroastrian king, Khosrau I of Persia, who orders the translation of Jataka stories into Persian.</td>
</tr>
<tr>
<td>538 or 552</td>
<td>Buddhism is introduced to Japan via Baekje (Korea), according to Nihonshoki; some scholars place this event in 538.</td>
</tr>
<tr>
<td>c. 575</td>
<td>Zen adherents enter Vietnam from China.</td>
</tr>
</tbody>
</table>

### 7th century

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>607</td>
<td>A Japanese imperial envoy is dispatched to Sui, China to obtain copies of sutras.</td>
</tr>
<tr>
<td>616–634</td>
<td>Jingwan begins carving sutras onto stone at Fangshan, Yuzhou, 75 km southwest of modern-day Beijing.</td>
</tr>
<tr>
<td>617–649</td>
<td>Reign of Songtsen Gampo of Tibet, who is traditionally held to be the first Tibetan King to promote the bringing of Buddhism to Tibet.</td>
</tr>
<tr>
<td>627–645</td>
<td>Xuanzang travels to India, noting the persecution of Buddhists by Sasanka (king of Gauda, a state in northwest Bengal) before returning to Chang'an in China to translate Buddhist scriptures.</td>
</tr>
<tr>
<td>c. 650</td>
<td>End of sporadic Buddhist rule in the Sindh.</td>
</tr>
<tr>
<td>671</td>
<td>Chinese Buddhist pilgrim Yi Jing visits Palembang, capital of the partly Buddhist kingdom of Srivijaya on the island of Sumatra, Indonesia, and reports over 1000 Buddhist monks in residence.</td>
</tr>
<tr>
<td>671</td>
<td>Uisang returns to Korea after studying Chinese Huayan Buddhism and founds the Hwaeom school.</td>
</tr>
</tbody>
</table>

### 8th century

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 8th century</td>
<td>Buddhist Jataka stories are translated into Syriac and Arabic as Kalilag and Damnag. An account of Buddha's life is translated into Greek by John of Damascus and widely circulated among Christians as the story of Barlaam and Josaphat. By the 14th century, this story of Josaphat becomes so popular that he is made a Catholic saint.</td>
</tr>
<tr>
<td>736</td>
<td>Huayan is transmitted to Japan via Korea, when Rōben invites the Korean Hwaeom monk Simsang to lecture, and formally founds Japan's Kegon tradition in the Tōdai-ji temple.</td>
</tr>
<tr>
<td>743–754</td>
<td>The Chinese monk Jianzhen attempts to reach Japan eleven times, succeeding in 754 to establish the Japanese Ritsu school, which specialises in the vinaya (monastic rules).</td>
</tr>
</tbody>
</table>
760–830 Construction is begun on Borobodur, the famous Indonesian Buddhist structure. It is completed as a Buddhist monument in 830, after about 50 years of work.

9th century

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>804</td>
<td>Under the reign of Emperor Kanmu of Japan, a fleet of four ships sets sail for mainland China. Of the two ships that arrive, one carries the monk Kūkai—recently ordained by the Japanese government as a Bhikkhu—who absorbs Vajrayana teachings in Chang'an and returns to Japan to found the Japanese Shingon school. The other ship carries the monk Saichō, who returns to Japan to found the Japanese Tendai school, partly based upon the Chinese Tiantai tradition.</td>
</tr>
<tr>
<td>838 to 841</td>
<td>Langdarma rules in Tibet, and persecutes Buddhism</td>
</tr>
<tr>
<td>838–847</td>
<td>Ennin, a priest of the Tendai school, travels in China for nine years. He reaches both the famous Buddhist mountain of Wutaishan and the Chinese capital, Chang'an, keeping a detailed diary that is a primary source for this period of Chinese history, including the Buddhist persecution.</td>
</tr>
<tr>
<td>841–846</td>
<td>Emperor Wuzong of the Tang Dynasty (given name: Li Yan) reigns in China; he is one of three Chinese emperors to prohibit Buddhism. From 843–845, Wuzong carries out the Great Anti-Buddhist Persecution, permanently weakening the institutional structure of Buddhism in China.</td>
</tr>
<tr>
<td>859</td>
<td>The Caodong school of Zen is founded by Dongshan Liangjie and his disciples in southern China.</td>
</tr>
</tbody>
</table>

10th century

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 10th century</td>
<td>Buddhist temple construction commences at Bagan, Myanmar.</td>
</tr>
<tr>
<td>c. 10th century</td>
<td>In Tibet, a strong Buddhist revival is begun.</td>
</tr>
<tr>
<td>971</td>
<td>Chinese Song Dynasty commissions Chengdu woodcarvers to carve the entire Buddhist canon for printing. Work is completed in 983; 130,000 blocks are produced, in total.</td>
</tr>
<tr>
<td>911</td>
<td>A printed copy of the Song Dynasty Buddhist canon arrives in Korea, impressing the government.</td>
</tr>
</tbody>
</table>

11th century
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 11th century</td>
<td>Marpa, Konchog Gyalpo, Atisha, and others introduce the Sarma lineages into Tibet.</td>
</tr>
<tr>
<td>1009</td>
<td>Vietnam's Lý Dynasty begins, which is partly brought about by an alliance with the Buddhist monkhood. Ly emperors patronize Mahayana Buddhism, in addition to traditional spirits.</td>
</tr>
<tr>
<td>1010</td>
<td>Korea begins carving its own woodblock print edition of the Buddhist canon. No completion date is known; the canon is continuously expanded, with the arrival of new texts from China.</td>
</tr>
<tr>
<td>1017</td>
<td>In Southeast Asia, and especially in Sri Lanka, the Bhikkhuni (Buddhist nuns) Order dies out due to invasions. The bhikkhu line in Sri Lanka is later revived with bhikkhus from Burma.</td>
</tr>
<tr>
<td>1025</td>
<td>Srivijaya, a Buddhist kingdom based in Sumatra, is raided by the Chola empire of southern India; it survives, but declines in importance. Shortly after the raid, the centre of the kingdom moves northward from Palembang to Jambi-Melayu.</td>
</tr>
<tr>
<td>1056</td>
<td>King Anawrahta of Pagan Kingdom converts to Theravada Buddhism.</td>
</tr>
<tr>
<td>1057</td>
<td>Anawrahta captures Thaton Lower Burma, strengthening Theravada Buddhism in the country.</td>
</tr>
<tr>
<td>1063</td>
<td>A copy of the Khitans' printed canon arrives in Korea from mainland China.</td>
</tr>
<tr>
<td>1070</td>
<td>Bhikkhus from Pagan arrive in Polonnaruwa, Sri Lanka to reinstate the Theravada ordination line.</td>
</tr>
<tr>
<td>1084–1112</td>
<td>In Myanmar, King Kyansittha reigns. He completes the building of the Shwezigon Pagoda, a shrine for relics of the Buddha, including a tooth brought from Sri Lanka. Various inscriptions refer to him as an incarnation of Vishnu, a chakravartin, a bodhisattva, and dharmaraja.</td>
</tr>
</tbody>
</table>

12th century

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1100–1125</td>
<td>Huizong reigns during the Chinese Song Dynasty and outlaws Buddhism to promote the Dao. He is one of three Chinese emperors to have prohibited Buddhism.</td>
</tr>
<tr>
<td>1133–1212</td>
<td>Hōnen establishes Pure Land Buddhism as an independent sect in Japan.</td>
</tr>
<tr>
<td>1171</td>
<td>Anawrahta of Pagan upon request of King Vijayabahu I of Ceylon sends monks and scriptures to restart Buddhism in the island kingdom.</td>
</tr>
<tr>
<td>1181</td>
<td>The self-styled bodhisattva Jayavarman VII, a devout follower of Mahayana Buddhism (though he also patronised Hinduism), assumes control of the Khmer kingdom. He constructs the Bayon, the most prominent Buddhist structure in the Angkor temple complex. This sets the stage for the later conversion of the Khmer people to Theravada Buddhism.</td>
</tr>
</tbody>
</table>
1190 | King Sithu II of Pagan realigns Burmese Buddhism with the Mahavihara school of Ceylon.

### 13th century

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>c. 1200</td>
<td>The great Buddhist educational centre at Nalanda, India, (the origin of Buddhism) where various subjects were taught subjects such as Buddhism, Logic, Philosophy, Law, Medicine, Grammar, Yoga, Mathematics, Alchemy, and Astrology, is sacked, looted and burnt by Muhammad bin Bakhtiyar Khilji.</td>
</tr>
<tr>
<td>1222</td>
<td>Birth of Nichiren Daishonin (1222–1282), the Japanese founder of Nichiren Buddhism.</td>
</tr>
<tr>
<td>1227</td>
<td>Dogen Zenji takes the Caodong school of Zen from China to Japan as the Sōtō sect.</td>
</tr>
<tr>
<td>1236</td>
<td>Bhikkhus from Kañcipuram, India, arrive in Sri Lanka to revive the Theravada ordination line.</td>
</tr>
<tr>
<td>1238</td>
<td>The Thai Kingdom of Sukhothai is established, with Theravada Buddhism as the state religion.</td>
</tr>
<tr>
<td>1244</td>
<td>Eiheiji Soto Zen Temple and Monastery are established by Dogen Zenji.</td>
</tr>
<tr>
<td>c.</td>
<td>Theravada overtakes Mahayana—previously practised alongside Hinduism—as the dominant form of Buddhism in Cambodia; Sri Lanka is an influence in this change.</td>
</tr>
<tr>
<td>1250</td>
<td>Kublai Khan makes the Buddhism (especially the Tibetan Buddhism) the de facto state religion of the Yuan dynasty, establishing the Bureau of Buddhist and Tibetan Affairs and appointing Sakya Imperial Preceptors.</td>
</tr>
<tr>
<td>1260–1270</td>
<td>Sukhothai's third and most famous ruler, Ram Khamhaeng (Rama the Bold), reigns and makes vassals of Laos, much of modern Thailand, Pegu (Burma), and parts of the Malay Peninsula, thus giving rise to Sukhothai artistic tradition. After Ram Khamhaeng's death, Sukhothai loses control of its territories as its vassals become independent.</td>
</tr>
<tr>
<td>1285</td>
<td>Arghun makes the Ilkhanate a Buddhist state.</td>
</tr>
<tr>
<td>1287</td>
<td>The Pagan Empire, the largest Theravada kingdom of Southeast Asia, falls due to Mongol invasions.</td>
</tr>
<tr>
<td>1295</td>
<td>Mongol leader Ghazan Khan is converted to Islam, ending a line of Tantric Buddhist leaders.</td>
</tr>
</tbody>
</table>

### 14th century

<table>
<thead>
<tr>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>c. 1300</td>
<td>In Persia, the historian Rashid-al-Din Hamadani records some eleven Buddhist texts circulating in Arabic translation, amongst which the Sukhavati-vyuha and Karanda-vyuha Sutras are recognizable. Portions of the Samyutta and Anguttara-Nikayas, along with parts of the Maitreya-vyakarana, are identified in this collection.</td>
</tr>
<tr>
<td>1305–1316</td>
<td>Buddhists in Persia attempt to convert Uldjaitu Khan.</td>
</tr>
</tbody>
</table>
1312 | In the Mahayana tradition during the 13th century, the Japanese Mugai Nyodai became the first female abbess and thus the first ordained female Zen master.

1321 | Soji Soto Zen Temple and Monastery established by Keizan Zenji.

1351 | In Thailand, U Thong, possibly the son of a Chinese merchant family, establishes Ayutthaya as his capital and takes the name of Ramathibodi.

1391–1474 | Gyalwa Gendun Drupa, first Dalai Lama of Tibet.

**15th century**

<table>
<thead>
<tr>
<th>Date</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1405–1431</td>
<td>The Chinese eunuch admiral Zheng He makes seven voyages in this period, through southeast Asia, India, the Persian Gulf, East Africa, and Egypt. At the time, Buddhism is well-established in China, so visited peoples may have had exposure to Chinese Buddhism.</td>
</tr>
</tbody>
</table>

**16th century**

<table>
<thead>
<tr>
<th>Date</th>
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<tbody>
<tr>
<td>1578</td>
<td>Altan Khan of the Tümed gives the title of Dalai Lama to Sonam Gyatso (later known as the third Dalai Lama).</td>
</tr>
</tbody>
</table>

**17th century**

<table>
<thead>
<tr>
<th>Date</th>
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</tr>
</thead>
<tbody>
<tr>
<td>c. 1600-1700s</td>
<td>When Vietnam divides during this period, the Nguyen rulers of the south choose to support Mahayana Buddhism as an integrative ideology for the ethnically plural society of their kingdom, which is also populated by Chams and other minorities.</td>
</tr>
<tr>
<td>1614</td>
<td>The Toyotomi family rebuilds a great image of Buddha at the Temple of Hōkōji in Kyōtō.</td>
</tr>
<tr>
<td>1615</td>
<td>The Oirat Mongols convert to the Geluk school of Tibetan Buddhism.</td>
</tr>
<tr>
<td>1635</td>
<td>In Zanabazar, the first Jebtsundamba Khutughtu is born as a great-grandson of Abadai Khan of the Khalkha.</td>
</tr>
<tr>
<td>1642</td>
<td>Güüshi Khan of the Khoshuud donates the sovereignty of Tibet to the fifth Dalai Lama.</td>
</tr>
</tbody>
</table>

**18th century**

<table>
<thead>
<tr>
<th>Date</th>
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</table>
1753  Sri Lanka reinstatement of monks ordination from Thailand – the Siyam Nikaya lineage.
1766–1767  In Thailand, many Buddhist texts are destroyed as the Burmese invade Ayutthaya.

19th century

<table>
<thead>
<tr>
<th>Date</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1802–1820</td>
<td>Nguyễn Ánh comes to the throne of the first united Vietnam; he succeeds by quelling the Tayson rebellion in south Vietnam with help from Rama I in Bangkok, then takes over the north from the remaining Trinh. After coming to power, he creates a Confucianist orthodox state and is eager to limit the competing influence of Buddhism. He forbids adult men to attend Buddhist ceremonies.</td>
</tr>
<tr>
<td>1820–1841</td>
<td>Minh Mạng reigns in Vietnam, further restricting Buddhism. He insists that all monks be assigned to cloisters and carry identification documents. He also places new restrictions on printed material and begins the persecution of Catholic missionaries and converts that his successors (not without provocation) continue.</td>
</tr>
<tr>
<td>1851–1868</td>
<td>In Thailand, King Mongkut—himself a former monk—conducts a campaign to reform and modernise the monkhood, a movement that has continued in the present century under the inspiration of several great ascetic monks from the northeast part of the country.</td>
</tr>
<tr>
<td>1860</td>
<td>In Sri Lanka, against all expectations, the monastic and lay communities bring about a major revival in Buddhism, a movement that goes hand in hand with growing nationalism; the revival follows a period of persecution by foreign powers. Since then, Buddhism has flourished, and Sri Lankan monks and expatriate lay people have been prominent in spreading Theravada Buddhism in Asia, the West, and even in Africa.</td>
</tr>
<tr>
<td>1879</td>
<td>A council is convened under the patronage of King Mindon of Burma to re-edit the Pali canon. The king has the texts engraved on 729 stones, which are then set upright on the grounds of a monastery near Mandalay.</td>
</tr>
<tr>
<td>1880</td>
<td>Madame Blavatsky and Colonel Olcott became the first Westerners to receive the refuges and precepts, the ceremony by which one traditionally becomes a Buddhist; thus Blavatsky was the first Western woman to do so.</td>
</tr>
<tr>
<td>1882</td>
<td>Jade Buddha Temple is founded in Shanghai, China, with two Jade Buddha statues imported from Burma.</td>
</tr>
<tr>
<td>1884</td>
<td>Irish-born U Dhammaloka ordained in Burma; first named but not first known western bhikkhu.</td>
</tr>
<tr>
<td>1896</td>
<td>Using Fa Xian's records, Nepalese archaeologists rediscover the great stone pillar of Ashoka at Lumbini.</td>
</tr>
<tr>
<td>1899</td>
<td>Gordon Douglas is ordained in Myanmar; until recently thought to be the first Westerner to be ordained in the Theravada tradition.</td>
</tr>
</tbody>
</table>

20th century
<table>
<thead>
<tr>
<th>Date</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1908</td>
<td>Charles Henry Allan Bennett, a British national previously ordained as a Theravada monk as Bhikkhu Ananda Metteyya in Burma leads the First Buddhist Mission to the West.</td>
</tr>
<tr>
<td>1911</td>
<td>U Dhammaloka tried for sedition for opposition to Christian missionaries in Burma.</td>
</tr>
<tr>
<td>1912</td>
<td>The German monk Nyanatiloka founded the first monastery for Western Theravada monks, the Island Hermitage, in Sri Lanka.</td>
</tr>
<tr>
<td>1922</td>
<td>Zenjuji Soto Mission is founded as the first Soto Zen temple in North America.</td>
</tr>
<tr>
<td>1930</td>
<td>Soka Gakkai is founded in Japan.</td>
</tr>
<tr>
<td>1949</td>
<td>Mahabodhi Temple in Bodh Gaya is returned to partial Buddhist control.</td>
</tr>
<tr>
<td>1950</td>
<td>World Fellowship of Buddhists is founded in Colombo, Sri Lanka.</td>
</tr>
<tr>
<td>1952</td>
<td>German Dharmaduta Society founded by Asoka Weeraratna in Colombo, Sri Lanka on September 21, 1952, to spread Buddhism in Germany and other western countries. It was originally known as Lanka Dharmaduta Society.</td>
</tr>
<tr>
<td>1954</td>
<td>The Sixth Buddhist Council is held in Rangoon, Burma, organized by U Nu. It ends in time for the 2500th anniversary of the passing of the Buddha according to the Burmese reckoning.</td>
</tr>
<tr>
<td>1955</td>
<td>The Buddhist Society of India is founded in Mumbai, Maharashtra, India.</td>
</tr>
<tr>
<td>1956</td>
<td>the father of the Indian Constitution and untouchable leader B. R. Ambedkar converts to Navayana Buddhism, with more than 650,000 followers—beginning the modern Neo-Buddhist movement.</td>
</tr>
<tr>
<td>1956</td>
<td>The Zen Studies Society is founded in New York City to support the work of D.T. Suzuki.</td>
</tr>
<tr>
<td>1957</td>
<td>Establishment of the Berlin Buddhist Vihara in Berlin – Frohnau, Germany with residential monks from Sri Lanka, by the German Dharmaduta Society upon purchase of Das Buddhistische Haus founded by Dr. Paul Dahlke in 1924. This is the first Theravada Buddhist Vihara in continental Europe.</td>
</tr>
<tr>
<td>1957</td>
<td>Caves near the summit of Pai-tai mountain, Fangshan district, 75 km southwest of Beijing, are reopened, revealing thousands of Buddhist sutas that had been carved onto stone since the 7th century. Seven sets of rubbings are made, and the stones are numbered, in work that continues until 1959.</td>
</tr>
<tr>
<td>1959</td>
<td>The 14th Dalai Lama flees Tibet amidst unrest and establishes an exile community in India. Monasteries that participated in or sheltered agents of partisan violence were damaged or destroyed in the fighting.</td>
</tr>
<tr>
<td>1962</td>
<td>The Dharma Realm Buddhist Association is founded by Tripitaka Master Shramana Hsuan Hua, who later founds the City of Ten Thousand Buddhas and ordains the first five fully ordained American Buddhist monks and nuns.</td>
</tr>
<tr>
<td>1962</td>
<td>The San Francisco Zen Center is founded by Shunryu Suzuki.</td>
</tr>
<tr>
<td>1963</td>
<td>Thich Quảng Đức immolates himself to protest the oppression of the Buddhist religion by Ngo Dinh</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
</tr>
<tr>
<td>------</td>
<td>-----------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1965</td>
<td>The Burmese government arrests over 700 monks in Hmawbi, near Rangoon, for refusing to accept government rule.</td>
</tr>
<tr>
<td>1965</td>
<td>The Johnstone House Trust was formed with the objectives &quot;to make available to the public facilities for study and meditation based on Buddhist and other religious teaching leading to mental and spiritual well-being, and to provide guidance for those in need of such help and in particular the utilisation of the property known as Johnstone House, Eskdalemuir, for such purposes.&quot; In 1967, the Johnstone House facilities were offered to Tibetan Buddhist lamas led by Akong Rinpoche, under whose guidance and direction the Kagyu Samyé Ling Tibetan Buddhist monastery became the first, and swiftly grew to become the largest, Tibetan Buddhist centre in Europe.</td>
</tr>
<tr>
<td>1965</td>
<td>The World Buddhist Sangha Council is convened by Theravadins in Sri Lanka with the hope of bridging differences and working together. The first convention is attended by leading monks from many countries and sects, Mahayana as well as Theravada. Nine Basic Points Unifying the Theravada and Mahayana are written by Ven. Walpola Rahula are approved unanimously.</td>
</tr>
<tr>
<td>1966</td>
<td>Freda Bedi, a British woman, becomes the first Western woman to take ordination in Tibetan Buddhism.</td>
</tr>
<tr>
<td>1966</td>
<td>The Johnstone House Trust was formed with the objectives &quot;to make available to the public facilities for study and meditation based on Buddhist and other religious teaching leading to mental and spiritual well-being, and to provide guidance for those in need of such help and in particular the utilisation of the property known as Johnstone House, Eskdalemuir, for such purposes.&quot; In 1967, the Johnstone House facilities were offered to Tibetan Buddhist lamas led by Akong Rinpoche, under whose guidance and direction the Kagyu Samyé Ling Tibetan Buddhist monastery became the first, and swiftly grew to become the largest, Tibetan Buddhist centre in Europe.</td>
</tr>
<tr>
<td>1967</td>
<td>Friends of the Western Sangha (later Friends of the Western Buddhist Order) founded by Urgyen Sangharakshita</td>
</tr>
<tr>
<td>1968</td>
<td>August. First ordinations into the Western Buddhist Order (Founder: Urgyen Sangharakshita)</td>
</tr>
<tr>
<td>1968</td>
<td>The Shurangama Sutra and Shurangama Mantra are lectured for the first time in the West (San Francisco) by Tripitaka Master Shramana Hsuan Hua during a 90-day retreat. The first five American Bhikshus and Bhikshunis are ordained in the Chinese tradition including the oldest still-in-robes American Bhikshuni nun Heng Chr.</td>
</tr>
<tr>
<td>1970s</td>
<td>Indonesian Archaeological Service and UNESCO restore Borobodur.</td>
</tr>
<tr>
<td>1974</td>
<td>Wat Pah Nanachat, the first monastery dedicated to providing training and support for western Buddhist monks in the Thai Forest Tradition is founded by Venerable Ajahn Chah in Thailand. The monks trained here would later establish branch monasteries throughout the world.</td>
</tr>
<tr>
<td>1974</td>
<td>The Naropa Institute (now Naropa University) is founded in Boulder, Colorado.</td>
</tr>
<tr>
<td>1974</td>
<td>In Burma, during demonstrations at U Thant's funeral, 600 monks are arrested and several are bayoneted by government forces.</td>
</tr>
<tr>
<td>1975</td>
<td>Lao Communist rulers attempt to change attitudes to religion—in particular, calling on monks to work, not beg. This causes many to return to lay life, but Buddhism remains popular.</td>
</tr>
<tr>
<td>1975</td>
<td>The Insight Meditation Society is established in Barre, Massachusetts.</td>
</tr>
<tr>
<td>1975–1979</td>
<td>Cambodian Communists under Pol Pot try to completely destroy Buddhism, and very nearly succeed. By the time of the Vietnamese invasion of Cambodia in 1978, nearly every monk and religious intellectual has been either murdered or driven into exile, and nearly every temple and Buddhist library has been destroyed.</td>
</tr>
</tbody>
</table>
1976  Bhikshus Rev. Heng Sure and Rev. Heng Chau, the American Buddhist Monk disciples of Ven. Tripitaka Master Hsuan Hua, for the sake of world peace, undertook an over six hundred mile three steps one bow pilgrimage from Los Angeles area to City of Ten Thousand Buddhas in Mendocino area, repeatedly taking three steps and one bow to cover the entire journey. In the entire 2.5 years taken to make the pilgrimage, Shramana Heng Sure observed a practice of total silence.

1976  Following a demonstration in Burma, the government seeks to discredit the critical monk La Ba by claiming that he is a cannibal and a murderer.

1978  In Burma, more monks and novices are arrested, disrobed, and imprisoned by the government. Monasteries are closed and property seized. The critical monk U Nayaka is arrested and dies, the government claiming it is suicide.

1980  The Burmese military government asserts authority over the sangha, and violence against monks continues through the decade.

1983  The Shanghai Institute of Buddhism is established at Jade Buddha Temple, under the Shanghai Buddhist Association.

1988  During the 1988 uprising, SPDC troops gun down monks. After the uprising, U Nyanissara, a senior monk, records a tape that discusses democracy in Buddhist precepts; the tape is banned.

In Estonia, the first political opposition party, Estonian National Independence Party was founded by the head of Estonian Buddhist Brotherhood, Vello Vaartnou.

1990  August 27 – Over 7000 monks meet in Mandalay, in Burma, to call for a boycott of the military. They refuse to accept alms from military families or perform services for them. The military government seizes monasteries and arrests hundreds of monks, including senior monks U Sumangala and U Yewata. The monks face long-term imprisonment, and all boycotting monks are disrobed; some monks are tortured during interrogation.

1992  The Buddha Statue of Hyderabad, India is installed, a work of former Chief Minister of Andhra Pradesh, Late Sri N.T. Rama Rao. The 16-meter tall, 350-ton monolithic colossus rises high from the placid waters of picturesque Husain Sagar Lake. It is made of white granite, finely sculptured and stands majestically amidst the shimmering waters of the lake. It is later consecrated by Dalai Lama.

1996  Subhana Barzagi Roshi became the Diamond Sangha's first female roshi (Zen teacher) when she received transmission on March 9, 1996, in Australia. In the ceremony Subhanna also became the first female roshi in the lineage of Robert Aitken Roshi.

1996  A Bhikkhuni (Buddhist nuns) Order and lineage is revived in Sarnath, India through the efforts of Sakyadhita, an International Buddhist Women Association. The revival is done with some resistance from some of the more literal interpreters of the Buddhist Vinaya (monastic code) and lauded by others in the community.

1998  January 25 – Liberation Tigers of Tamil Eelam (LTTE) terrorists commit a deadly suicide attack on Sri
Lanka's most sacred Buddhist site and a UNESCO World Heritage centre: the Temple of the Tooth, where Buddha's tooth relic is enshrined. Eight civilians are killed and 25 others are injured and significant damage is done to the temple structure, which was first constructed in 1592.

1998

Sherry Chayat, born in Brooklyn, became the first American woman to receive transmission in the Rinzai school of Buddhism.

### 21st century

<table>
<thead>
<tr>
<th>Date</th>
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</thead>
<tbody>
<tr>
<td>2001</td>
<td>May – Two of the world's tallest ancient Buddha statues, the Buddhas of Bamyan, are completely destroyed by the Taliban in Bamyan, Afghanistan.</td>
</tr>
<tr>
<td>2002</td>
<td>Khenmo Drolma, an American woman, became the first bhikkhuni in the Drikung Kagyu lineage of Buddhism, getting ordained in Taiwan in 2002.</td>
</tr>
<tr>
<td>2004</td>
<td>Khenmo Drolma became the first westerner, male or female, to be installed as an abbot in the Drikung Kagyu lineage of Buddhism. She was installed as the abbot of the Vajra Dakini Nunnery in 2004. The Vajra Dakini Nunnery does not follow The Eight Garudhammas.</td>
</tr>
<tr>
<td>2004</td>
<td>April – In Sri Lanka, Buddhist monks acting as candidates for the Jaathika Hela Urumaya party win nine seats in elections.</td>
</tr>
<tr>
<td>2006</td>
<td>Merle Kodo Boyd, born in Texas, became the first African–American woman ever to receive Dharma transmission in Zen Buddhism.</td>
</tr>
<tr>
<td>2006</td>
<td>For the first time in American history, a Buddhist ordination was held where an American woman (Sister Khanti-Khema) took the Samaneri (novice) vows with an American monk (Bhante Vimalaramsi) presiding. This was done for the Buddhist American Forest Tradition at the Dhamma Sukha Meditation Center in Missouri.</td>
</tr>
<tr>
<td>2007</td>
<td>Myokei Caine-Barrett, born and ordained in Japan, became the first female Nichiren priest in her affiliated Nichiren Order of North America.</td>
</tr>
<tr>
<td>2008</td>
<td>After a 10-year process of advanced training culminating in a ceremony called shitsugo (literally &quot;room-name&quot;), Sherry Chayat received the title of roshi and the name Shinge (&quot;Heart/Mind Flowering&quot;) from Eido Roshi, which was the first time that this ceremony was held in the United States.</td>
</tr>
<tr>
<td>2010</td>
<td>Western Buddhist Order (Founder: Urgyen Sangharakshita) changes name to Triratna Buddhist Order and Friends of the Western Buddhist Order to Triratna Buddhist Community.</td>
</tr>
<tr>
<td>2010</td>
<td>The first Tibetan Buddhist nunnery in America (Vajra Dakini Nunnery in Vermont) was officially opened.</td>
</tr>
</tbody>
</table>
consecrated. It offers novice ordination and follows the Drikung Kagyu lineage of Buddhism. The abbot of the Vajra Dakini nunnery is Khenmo Drolma, an American woman, who is the first bhikkhuni in the Drikung Kagyu lineage of Buddhism, having been ordained in Taiwan in 2002. She is also the first westerner, male or female, to be installed as an abbot in the Drikung Kagyu lineage of Buddhism, having been installed as the abbot of the Vajra Dakini Nunnery in 2004. The Vajra Dakini Nunnery does not follow The Eight Garudhammas.

2010 In Northern California, 4 novice nuns were given the full bhikkhuni ordination in the Thai Theravada tradition, which included the double ordination ceremony. Bhante Gunaratana and other monks and nuns were in attendance. It was the first such ordination ever in the Western hemisphere. The following month, more bhikkhuni ordinations were completed in Southern California, led by Walpola Piyananda and other monks and nuns. The bhikkhunis ordained in Southern California were Lakshapathiye Samadhi (born in Sri Lanka), Cariyapanna, Susila, Sammasati (all three born in Vietnam), and Uttamanyana (born in Myanmar).

2010 The Soto Zen Buddhist Association (SZBA) approves a document honoring the women ancestors in the Zen tradition at its biannual meeting on October 8, 2010. Female ancestors, dating back 2,500 years from India, China, and Japan, may now be included in the curriculum, ritual, and training offered to Western Zen students.

2011 The Institute for Buddhist Dialectical Studies (IBD) in Dharamsala, India, conferred the degree of geshe on Venerable Kelsang Wangmo, a German nun, thus making her the world's first female geshe.

2013 Tibetan women were able to take the geshe exams for the first time.

2014 Nalanda University (also known as Nalanda International University) is a newly established university located in Rajgir, near Nalanda, Bihar, India. It has been established in a bid to revive the ancient seat of learning. The university has acquired 455 acres of land for its campus and has been allotted ₹2727 crores (around $454M) by the Indian government. It is also being funded by the governments of China, Singapore, Australia, Thailand, and others.

2016 Twenty Tibetan Buddhist nuns became the first Tibetan women to earn geshe degrees.

Timeline of Jainism

Before common era (BCE)

- 584,979–574,979 BCE: Naminatha, 21st Tirthankara
- Neminatha, 22nd Tirthankara: According to Jain beliefs, he lived 84,650 years before the 23rd Tirthankara, Parshvanatha. He existed in the Mahabharata era and was the cousin brother of Krishna.
- 877–777 BCE: Parshva, 23rd Tirthankar of Jainism. He is the earliest Jain leader who can be reliably dated.
• 599–527 BCE: Mahavira, 24th and last Tirthankar of this era.
• 5th century BCE: Siddhasen Diwakar
• d. 507 BCE: Ganahar Sudharma Swami
• d. 357 BCE: Acharya Bhadrabahu
• d. 162 BCE: Hathigumpha inscription mentions the *Namokar Mantra* and Jain monarch Kharvela.
• 2nd century BCE: *Namokar Mantra* epigraphically attested in Maharashtra

**Common era (CE)**

• 1st century CE: Acharya Kundkund
• 87 CE: Pushpadanta starts to write Shatkhandagam
• 156 CE: Acharya Bhutabali completes writing of Shatkhandagam
• 454 CE: Devardhigani compiles Jain Agamas
• 5th century CE: first mention of the Mula Sangh order

**Middle Ages**

• 9th century
  • The Tirumalai complex in Tamil Nadu is established.
• 10th century
  • Life of Nemichandra, a famous Jain author.
  • Jain temple of Gurjiwada, Cudnem, Bicholim, Goa was constructed.
  • 982: Monolithic statue of Bahubali erected at Shravana belagola
• 12th century
  • Kashtha Sangh
  • 1172: Acharya Hemachandra
  • 1194: Tristutik
• 13th century
  • 1229: Tapa Gachchha
• 15th century
  • Ancient Jain temple of Gurjiwada, Cudnem, Bicholim, Goa was in ruins.
- 17th century
  - 1664: Digambar Terapanth
  - 1658: Digambara Jain Lal Mandir temple in Delhi built.

- 18th century
  - 1760: Swetembar Terapanth
  - 1780: Sthanakvasi and Terapanthi orders

**British India**

- 1868: Jain temple in Mumbai
- 1880s: reform movement of Acharya Rajendrasuri
- 1904: Jain temple at the Louisiana Purchase Exposition
- 1927: Madras High Court in Gateppa v. Eramma and others recognizes "Jainism as a distinct religion"

**Post-Partition**

- 1970s: significant presence of Jainism in the United States
- 1972: Aacharya Shri Vidyasagar Maharaj elevated to the Acharya status.
- 1975: Acharya Sushil Kumar (Jain monk) ji travels to USA. The first Jain muni to travel by air out of the Indian subcontinent.
- 1975: Monolithic statue of Bahubali is installed at Dharmansthal, Karnataka, India under the auspices of D. Rathnavarma Heggade and Mathrushree D. Rathnamma Heggade, members of Dharmansthal's Jaina lineage who also manage the local Shivaite temple. Carving work began in 1966 under the sculptor Rejala Gopalkrishna Shenoy of Karkala.
- 1976: In Arya Samaj Education Trust, Delhi & Others v. The Director of Education, Delhi Administration, Delhi & Others (AIR 1976 Delhi 207), the Court referred to Heinrich Zimmer's *Philosophies of India* describing Jainism as "a heterodox Indian religion" and J. N. Farquhar's *Modern Religious Movements in India* describing Jainism as "a rival of Hinduism."
- 1981: First Jain convention in Los Angeles
- 1983: Formal organization of JAINA (Jain Associations in North America)
- 1990: Temple Pratishtha, The Jain Sangh Cherry Hill, New Jersey
- 1990: Temple Pratishtha, Jain Society of Metropolitan Washington
• 1991: Founding of Siddhachalam, the Jain tirtha
• 1991: Death of Jain Acharya Shri Ramchandra Surishwarji
• 1993: Temple Pratishtha, Jain Society of Metropolitan Chicago
• 1995: Temple Pratishtha, Jain Center of Cincinnati and Dayton
• 1998: Temple Pratishtha, Jain Society of Greater Detroit
• 2000: Temple Pratishtha, Jain Center of Northern California (JCNC)
• 2000: Jain Vishwa Bharati Orlando
• 2005: the Supreme Court of India declined to grant Jains the status of a religious minority throughout India, leaving it to the respective states to decide on the minority status of Jainis.
• 2008: Delhi city government declares Jain community a minority per the Supreme Court Orders.
• 2014: Jain community is designated a minority at the national level.

Timeline of Western philosophers

Greek philosophers

600–500 BCE

• Thales of Miletus (c. 624 – 546 BCE). Of the Milesian school. Believed that all was made of water.
• Pherecydes of Syros (c. 620 – c. 550 BCE). Cosmologist.
• Anaximander of Miletus (c. 610 – 546 BCE). Of the Milesian school. Famous for the concept of Apeiron, or "the boundless".
• Anaximenes of Miletus (c. 585 – 525 BCE). Of the Milesian school. Believed that all was made of air.
• Pythagoras of Samos (c. 580 – c. 500 BCE). Of the Ionian School. Believed the deepest reality to be composed of numbers, and that souls are immortal.
• Xenophanes of Colophon (c. 570 – 480 BCE). Advocated monotheism. Sometimes associated with the Eleatic school.
• Epicharmus of Kos (c. 530 – 450 BCE). Comic playwright and moralist.
500–400 BCE

- Parmenides of Elea (c. 515 – 450 BCE). Of the Eleatics. Reflected on the concept of Being.
- Hippias (Middle of the 5th century BCE). Sophist.
- Socrates of Athens (c. 470 – 399 BCE). Emphasized virtue ethics. In epistemology, understood dialectic to be central to the pursuit of truth.
- Critias of Athens (c. 460 – 413 BCE). Atheist writer and politician.
- Leucippus of Miletus (First half of the 5th century BCE). Founding Atomist, Determinist.
- Thrasymachus of Miletus (c. 459 – c. 400 BCE). Sophist.
- Democritus of Abdera (c. 450 – 370 BCE). Founding Atomist.
- Diagoras of Melos (c. 450 – 415 BCE). Atheist.
- Archelaus. A pupil of Anaxagoras.
- Melissus of Samos. Eleatic.
- Cratylus. Follower of Heraclitus.
- Ion of Chios. Pythagorean cosmologist.
- Echecrates. Pythagorean.
- Timaeus of Locri. Pythagorean.

400–300 BCE

• Diogenes of Apollonia (c. 425 – c 350 BCE). Cosmologist.
• Hippo (c. 425 – c 350 BCE). Atheist cosmologist.
• Xenophon (c. 427 – 355 BCE). Historian.
• Plato (c. 427 – 347 BCE). Famed for view of the transcendental forms. Advocated polity governed by philosophers.
• Speusippus (c. 408 – 339 BCE). Nephew of Plato.
• Eudoxus of Cnidus (c. 408 – 355 BCE). Pupil of Plato.
• Diogenes of Sinope (c. 404 – 323 BCE). Cynic.
• Xenocrates (c. 396 – 314 BCE). Disciple of Plato.
• Aristotle (c. 384 – 322 BCE). A polymath whose works ranged across all philosophical fields.

**Hellenistic era philosophers**

**300–200 BCE**

• Theophrastus (c. 371 – c. 287 BCE). Peripatetic.
• Pyrrho of Elis (c. 360 – 270 BCE). Skeptic.
• Strato of Lampsacus (c. 340 – c. 268 BCE). Atheist, Materialist.
• Theodorus the Atheist (c. 340 – c. 250 BCE). Cyrenaic.
• Epicurus (c. 341 – 270 BCE). Materialist Atomist, hedonist. Founder of Epicureanism
• Zeno of Citium (c. 333 – 264 BCE). Founder of Stoicism.
• Timon (c. 320 – 230 BCE). Pyrrhonist, skeptic.
• Aristarchus of Samos (c. 310 – c. 230 BCE). Astronomer.
• Euclid (fl. 300 BCE). Mathematician, founder of geometry.
• Archimedes (c. 287 – c. 212 BCE). Mathematician and inventor.
• Chrysippus of Soli (c. 280 – 207 BCE). Major figure in Stoicism.
• Eratosthenes (c. 276 BC – c. 195/194 BCE). Geographer and mathematician.

**200–100 BCE**

• Carneades (c. 214 – 129 BCE). Academic skeptic. Understood probability as the purveyor of truth.
• Hipparchus of Nicaea (c. 190 – c. 120 BCE). Astronomer and mathematician, founder of trigonometry.
Roman era philosophers

100 BCE – 1 CE

- Cicero (c. 106 BCE – 43 BCE) Skeptic. Political theorist.

1–100 CE

- Philo (c. 20 BCE – 50 CE). Believed in the allegorical method of reading texts.
- Seneca the Younger (c. 4 BCE – 65 CE). Stoic.
- Quintilian (c. 35 CE – c. 100 CE). Rhetorician and teacher.
- Hero of Alexandria (c. 10 CE – c. 70 CE). Engineer.

100–200 CE


200–400 CE

- Sextus Empiricus (fl. during the 2nd and possibly the 3rd centuries AD). Skeptic, Pyrrhonist.
- Plotinus (c. 205 – 270). Neoplatonist. Had a holistic metaphysics.
- Porphyry (c. 232 – 304). Student of Plotinus.
- Iamblichus of Syria (c. 245 – 325). Late neoplatonist. Espoused theurgy.
- Proclus (c. 412 – 485). Neoplatonist.

Medieval philosophers

500–800 CE

- Boethius (c. 480–524).
- John Philoponus (c. 490–570).
- John of Damascus (c. 680-750).
800–900 CE

- Al-Kindi (c. 801 – 873). Major figure in Islamic philosophy. Influenced by Neoplatonism.
- John the Scot (c. 815 – 877). Neoplatonist, pantheist.

900–1000 CE

- Saadia Gaon (c. 882 – 942).
- al-Razi (c. 865 – 925). Rationalist. Major Islamic philosopher. Held that God creates universe by rearranging pre-existing laws.

1000–1100 CE

- Ibn Sina (Avicenna) (c. 980 – 1037). Major Islamic philosopher.

1100–1200 CE

- Abraham ibn Daud (c. 1110–1180). Jewish philosophy.
- Peter Lombard (c. 1100–1160). Scholastic.
- Sohrevardi (c. 1154–1191). Major Islamic philosopher.
- St Francis of Assisi (c. 1182–1226). Ascetic.

1200–1300 CE
• Fibonacci (c. 1170–c. 1250), mathematician.
• Michael Scot (1175–c. 1232), mathematician.
• Robert Grosseteste (c. 1175–1253).
• Albert the Great (Albertus Magnus) (c. 1193–1280). Early Empiricist.
• Roger Bacon (c. 1214–1294). Empiricist, mathematician.
• Ibn Sab'in (1217–1271 CE).
• Thomas Aquinas (c. 1221–1274). Christian philosopher.
• Bonaventure (c. 1225–1274). Franciscan.
• Siger (c. 1240–c. 1280). Averroist.
• Boetius of Dacia. Averroist, Aristotelian.

1300–1400 CE

• Ramon Llull (c. 1232–1315) Catalan philosopher
• Meister Eckhart (c. 1260–1328). mystic.
• Duns Scotus (c. 1266–1308). Franciscan, Scholastic, Original Sin.
• Marsilius of Padua (c. 1270–1342). Understood chief function of state as mediator.
• Gersonides (c. 1288–1344). Jewish philosopher.
• Jean Buridan (c. 1300–1358). Nominalist.
• John Wycliffe (c. 1320–1384).
• Nicole Oresme (c. 1320–5 – 1382). Made contributions to economics, science, mathematics, theology and philosophy.
• Ibn Khaldun (1332 – 1406).
• Hasdai Crescas (c. 1340 – c. 1411). Jewish philosopher.
• Gemistus Pletho (c. 1355 – 1452/1454). Late Byzantine scholar of neoplatonic philosophy.

1400–1500 CE

• Nicholas of Cusa (1401–1464). Christian philosopher.
• Lorenzo Valla (1407–1457). Humanist, critic of scholastic logic.
- Marsilio Ficino (1433–1499). Christian Neoplatonist, head of Florentine Academy and major Renaissance Humanist figure. First translator of Plato's complete extant works into Latin.
- Pico della Mirandola (1463–1494). Renaissance humanist.

**Early modern philosophers**

**1500–1550 CE**

- Desiderius Erasmus (1466–1536). Humanist, advocate of free will.
- Sir Thomas More (1478–1535). Humanist, created term "utopia".
- Martin Luther (1483–1546). Major Western Christian theologian.
- Petrus Ramus (1515–1572).

**1550–1600 CE**

- Michel de Montaigne (1533–1592). Humanist, skeptic.
- Pierre Charron (1541–1603).

**1600–1650 CE**

- Francis Bacon (1561–1626). Empiricist.
- François de La Mothe Le Vayer (1588–1672)
- Marin Mersenne (1588–1648). Cartesian.
• Robert Filmer (1588–1653).
• René Descartes (1596–1650). Heliocentrism, mind-body dualism, rationalism.
• Baltasar Gracián (1601–1658). Spanish catholic philosopher

1650–1700 CE

• Thomas Hobbes (1588–1679). Political realist.
• Antoine Arnauld (1612–1694).
• François de La Rochefoucauld (1613–1680).
• Henry More (1614–1687).
• Jacques Rohault (1617–1672). Cartesian.
• Margaret Cavendish (1623–1673). Materialist, feminist.
• Arnold Gueulincx (1624–1669). Important occasionalist theorist.
• Pierre Nicole (1625–1695).
• Geraud Cordemoy (1626–1684). Dualist.
• Robert Boyle (1627–1691).
• Anne Conway, Viscountess Conway (1631–1679).
• Richard Cumberland (1631–1718). Early proponent of utilitarianism.
• Baruch Spinoza (1632–1677).
• Joseph Glanvill (1636–1680).
• Nicolas Malebranche (1638–1715). Cartesian.
• Isaac Newton (1643–1727).
• Simon Foucher (1644–1696). Skeptic.
• Damaris Masham (1659–1708).
• John Toland (1670–1722).

1700–1750 CE

• Gottfried Leibniz (1646–1716). Co-inventor of calculus.
• John Norris (1657–1711).
• Jean Meslier (1664–1729). Atheist Priest.
• Giambattista Vico (1668–1744).
• Bernard Mandeville (1670–1733).
• Anthony Ashley-Cooper (1671–1713).
• Samuel Clarke (1675–1729).
• Catherine Cockburn (1679–1749).
• Christian Wolff (1679–1754). Determinist, rationalist.
• George Berkeley (1685–1753). Idealist, empiricist.
• Charles de Secondat, Baron de Montesquieu (1689–1755). Skeptic, humanist.
• Joseph Butler (1692–1752).
• Francis Hutcheson (1694–1746). Proto-utilitarian.
• John Gay (1699–1745).
• David Hartley (1705–1757).
• Julien La Mettrie (1709–1751). Materialist, genetic determinist.

1750–1800 CE

• Voltaire (1694–1778). Advocate for freedoms of religion and expression.
• Thomas Reid (1710–1796). Member of Scottish Enlightenment, founder of Scottish Common Sense philosophy.
• David Hume (1711–1776). Empiricist, skeptic.
• Denis Diderot (1713–1784).
• Alexander Gottlieb Baumgarten (1714–1762).
• Etienne de Condillac (1715–1780).
Jean d'Alembert (1717–1783).
Baron d'Holbach (1723–1789). Materialist, atheist.
Adam Smith (1723–1790). Economic theorist, member of Scottish Enlightenment.
Immanuel Kant (1724–1804). Deontologist, proponent of synthetic a priori truths.
Moses Mendelssohn (1729–1786). Member of the Jewish Enlightenment.
Gotthold Ephraim Lessing (1729–1781).
Edmund Burke (1729–1797). Conservative political philosopher.
William Paley (1743–1805).
Sylvain Maréchal (1750–1803) Anarcho-Communist, Deist
Dugald Stewart (1753–1828).
Mary Wollstonecraft (1759–1797). Feminist.
Friedrich Schiller (1759–1805).
Johann Gottlieb Fichte (1762–1814).

Modern philosophers

1800–1850 CE

Jean-Baptiste Lamarck (1744–1829). Early evolutionary theorist.
Joseph de Maistre (1753–1821) Conservative
Madame de Staël (1766–1817).
G. W. F. Hegel (1770–1831). German idealist.
Bernard Bolzano (1781–1848).
• Richard Whately (1787–1863).
• John Austin (1790–1859). Legal positivist, utilitarian.
• William Whewell (1794–1866).
• Auguste Comte (1798–1857). Social philosopher, positivist.
• Ralph Waldo Emerson (1803–1882). Transcendentalist, abolitionist, egalitarian, humanist.
• Ludwig Feuerbach (1804–1872).
• Alexis de Tocqueville (1805–1859).
• Max Stirner (1806–1856). Anarchist.
• Augustus De Morgan (1806–1871). Logician.
• Charles Darwin (1809–1882). Scientist, whose works affected Philosophy of Science.
• Jaime Balmes (1810–1848)
• Margaret Fuller (1810–1850). Egalitarian.
• Søren Kierkegaard (1813–1855). Existentialist.
• Henry David Thoreau (1817–1862). Transcendentalist, pacifist, abolitionist.

1850–1900 CE

• Sir William Hamilton, 9th Baronet (1788–1856).
• Sojourner Truth (c. 1797–1883). Egalitarian, abolitionist.
• Harriet Taylor Mill (1807–1858). Egalitarian, utilitarian.
• Mikhail Bakunin (1814–1876). Revolutionary anarchist.
• Elizabeth Cady Stanton (1815–1902). Egalitarian.
• Hermann Lotze (1817–1881).
• Karl Marx (1818–1883). Socialist, formulated historical materialism.
• Friedrich Engels (1820–1895). Egalitarian, dialectical materialist.
• Herbert Spencer (1820–1903). Nativism, libertarianism, social Darwinism.
• Susan B. Anthony (1820–1906). Feminist.
• Wilhelm Dilthey (1833–1911).
- Friedrich Nietzsche (1844–1900). Naturalistic philosopher, influence on Existentialism.
- Gottlob Frege (1848–1925). Influential analytic philosopher.
- David George Ritchie (1853–1903). Idealist.
- Alexius Meinong (1853–1920). Logical realist.
- Andrew Seth Pringle-Pattison (1856–1931).
- Émile Durkheim (1858–1917). Social philosopher.
- Giuseppe Peano (1858–1932).
- Henri Bergson (1859–1941).
• Pierre Duhem (1861–1916).
• George Herbert Mead (1863–1931). Pragmatism, symbolic interactionist.
• Miguel de Unamuno (1864–1936).
• J. M. E. McTaggart (1866–1925). Idealist.
• Benedetto Croce (1866–1952).
• Emma Goldman (1869–1940). Anarchist.
• Rosa Luxemburg (1870–1919). Marxist political philosopher.

1900–2000 CE

• George Santayana (1863–1952). Pragmatism, naturalism; known for many aphorisms.
• Nikolai Berdyaev (1874–1948). Existentialist.
• Ernst Cassirer (1874–1945).
• Max Scheler (1874–1928). German phenomenologist.
• Giovanni Gentile (1875–1944). Idealist and fascist philosopher.
• Ralph Barton Perry (1876–1957).
• W.D. Ross (1877–1971). Deontologist.
• Martin Buber (1878–1965). Jewish philosopher, existentialist.
• Ludwig von Mises (1881-1973).
• Moritz Schlick (1882–1936). Founder of Vienna Circle, logical positivism.
• Otto Neurath (1882–1945). Member of Vienna Circle.
- Nicolai Hartmann (1882–1950).
- Walter Terence Stace (1886–1967)
- Karl Barth (1886–1968).
- C. D. Broad (1887–1971).
• Mortimer Adler (1902–2001).
• Ernest Addisom Moody (1903–1975).
• Emmanuel Levinas (1906–1995).
• C.L. Stevenson (1908–1979).
• Simone de Beauvoir (1908–1986). Existentialist, feminist.
• Willard van Orman Quine (1908–2000).
• Simone Weil (1909–1943).
• J.L. Austin (1911–1960).
• Donald Davidson (1917–2003).
• Louis Althusser (1918–1990).
• M. Bunge (1919–2020).
- R. M. Hare (1919–2002).
- Frantz Fanon (1925–1961). Postcolonialism
- Gilles Deleuze (1925–1995). Post-structuralism
- Jürgen Habermas (born 1929).
- Charles Taylor (born 1931). Political philosophy, Philosophy of Social Science, and Intellectual History
- John Searle (born 1932).
- Alvin Plantinga (born 1932). Reformed epistemology, Philosophy of Religion.
- Thomas Nagel (born 1937).
• Alain Badiou (born 1937).
• Saul Kripke (born 1940).
• Jean-Luc Nancy (born 1940) French philosopher.
• Joze Azurmendi (born 1941). Basque Philosopher, Political philosophy, Social philosophy, Philosophy of language.
• Derek Parfit (1942–2017).
• Gayatri Chakravorty Spivak (born 1942). Postcolonialism, Feminism, Literary theory.
• Peter Singer (born 1946) Moral philosopher on animal liberation, effective altruism.
• John Ralston Saul (born 1947).
• Slavoj Žižek (born 1949). Hegelianism, Marxism and Lacanian psychoanalysis.
• Ken Wilber (born 1949). Integral Theory.
• Luc Ferry (born 1951).
• André Comte-Sponville (born 1952).
• Cornel West (born 1953).
• Judith Butler (born 1956). Poststructuralist, feminist, queer theory.
• Michel Onfray (born 1959).
• Alain de Botton (born 1969).

Timeline of Eastern philosophers
Chinese philosophers

Ancient Chinese philosophers

Before 256 BCE (until the end of the Zhou dynasty)

- Guan Zhong (died in 645 BCE)
- Confucius (traditionally 551–479 BCE) — founder of Confucianism
- Sun Tzu (c. 544–c. 496 BCE) — military philosopher
- Laozi (probably 6th century BCE) — founder of Taoism

475–221 BCE (Warring States period)

- Gaozi (c. 420 BCE)
- Liezi (c. 440 – c. 360 BCE)
- Mencius (most accepted dates: 372–289 BCE; other possible dates: 385–303 BCE or 302 BCE) — political philosopher, social contract
- Mozi (c. 470 – c. 390 BCE) — political and religious philosopher
- Gongsun Longzi (fl. 300 BCE) — School of Names
- Xu Xing (c. 315 BCE)
- Hui Shi (4th century BCE) — School of Names
- Shang Yang (died 338 BCE) — Legalist bureaucrat
- Shen Buhai (died 337 BCE) — Legalist bureaucrat
- Shen Dao (c. 350–275 BCE)
- Song Xing (360–290 BCE)
- Yang Zhu (370–319 BCE) — Usually classified as a Hedonist
- Zhuang Zhou (Zhuangzi, c. 4th century BCE) — major Taoist philosopher
- Han Feizi (died 233 BCE) — totalistic legalism
- Xunzi (c.310–237 BCE) — Confucianist, pessimistic about human nature
- Zou Yan (305?–240? BCE) — School of Naturalists, Yin-Yang, Five Elements

221 BCE – 220 CE (Qin, Han and Xin dynasties)
- Zheng Xuan (127–200 CE)
- Jia Yi (201–169 BCE)
- Dong Zhongshu (c. 176 – c. 104 BCE)
- He Yan (190–249 CE)
- Liu An (179–122 BCE)
- Wang Chong (27–97 CE)
- Yang Xiong (53 BCE – 18 CE)

220 CE – 907 CE (Three Kingdoms period to Tang dynasty)

- Ruan Ji (210–263)
- Wang Bi (226–249) — commentator on the Tao Te Ching and the I Ching
- Guo Xiang (died 312)
- Zhi Dun (314–366)
- Sengzhao (384–414)
- Ge Hong (4th century)
- Zhiyi (538–597)
- Jizang (549–623)
- Huineng (638–713)
- Fazang (643–712)
- Li Ao (722–841)
- Han Yu (768–824)
- Zongmi (780–841)
- Linji Yixuan (died 866)

907–1368 (Five Dynasties and Ten Kingdoms period to Yuan dynasty)

- Chang Tsai (1020–1077)
- Cheng Hao (1032–1085) — established the Confucian "School of Mind"
- Cheng Yi (1033–1107)
- Zhou Dunyi (1017–1073)
- Hu Yuan (993–1059) — revived Confucianism

1209
• Shao Yung (1011–1077)
• Zhu Xi (1130–1200) — thinker of the Confucianist "School of Principle"
• Hu-Hung (1100–1155)
• Lu Jiuyuan (1139–1193)

1368–1912 (Ming and Qing dynasties)

• Zhang Xuecheng (1738–1801)
• Ch'ên Hsien-chang (1428–1500)
• Chiao Hung (1540–1620)
• Huang Zongxi (1610–1695)
• Kang Youwei (1858–1927)
• Liang Qichao (1873–1929)
• Liu Tsung-chou (1578–1645)
• Sun Yat-sen (1866–1925)
• Dai Zhen (1724–1777)
• Tan Sitong (1864–1898)
• Wang Fuzhi (1619–1692)
• Wang Yangming (1472–1529)
• Yen Yuan (1635–1704)
• Yu Zhengxie (1775–1840) — prominent scholar and male feminist, philosopher, philologist, astrologer

Modern Chinese philosophers

1912–1950

• Ch’ien Mu (1895–1990)
• Thomé H. Fang (1899–1976)
• Feng Youlan (1895–1990)
• Xiong Shili (1885–1968)
• Xu Fuguan (1903–1982)
• Hu Shih (1891–1962)
• Liang Shuming (1893–1988)
• Zhang Dongsun (1886–1973)
• Liu Shaoqi (1898–1969)
• Mao Zedong (1893–1976)
• Mou Tsung-san (1909–1995)
• T‘ang Chun-i (1909–1978)
• Hao Wang (1921–1995)

Indian philosophers

Ancient Indian philosophers

Early Vedic age 1500–800 BCE (Saptarishi)

• Vasishtha
• Atri
• Vishvamitra
• Agastya
• Gautama Maharishi
• Jamadagni
• Bharadwaja

Late Vedic age 800–400 BCE (Sectarianism)

• Parshvanatha (between 872–772 BCE) Parshvanatha is the earliest Jain tirthankara who is generally acknowledged as a historical figure.
• Aruni (between 750–650 BCE) credited with laying the foundation of Indian atomism
• Yajnavalkya (between 700–600 BCE) credited for coining Advaita (non-dual, monism), an important tradition within Hinduism
• Makkhalı Gosala (between 600–500 BCE) — founder Ājīvika philosophy
• Pāṇini (between 600–500 BCE) — made contributions to Philosophy of language and Sanskrit grammar
• Siddhartha Gautama (c. 563–483 BCE) — founder of Buddhism
• Mahākāśyapa — Most Venerable Mahā Kāśyapa Maha Thero
• Bṛhaspati — Founder of Cārvāka philosophy
• Mahavira (599–527 BCE) — heavily influenced Jainism, the 24th Tirthankara of Jainism
• Badarayana (lived between 500 BCE and 400 BCE) — Author of Brahma Sutras
• Kapila (c. 500 BCE) founder of Sankhya philosophy

321–184 BCE (Maurya Empire)

• Shvetashvatara — Author of earliest textual exposition of a systematic philosophy of Shaivism
• Chanakya (c. 350–275 BCE) — A pioneer in the field of economics and political science
• Jaimini (c. 300–200 BCE) — Author of Purva Mimamsa Sutras
• Aksapada Gautama (c. 2nd century BCE) — founder of Nyaya philosophy
• Kanada — founder of Vaisheshika
• Pingala — Renowned for his work on Combinatorics and Sanskrit prosody

184 BCE–100 CE (Early Middle Kingdoms Begin – The Golden Age)

• Patanjali — Author of Yoga Sutra and a commentary on Panini
• Thiruvalluvar (c. 1st century BCE–2nd century CE), best known for authoring the Tirukkuṟaḷ, a collection of couplets on ethics

100–300 (Cholas, Cheras, Pandavas and Kushan Empire)

• Nagarjuna (c. 150–250) — founder of Madhyamaka Buddhism
• Kundakunda (c. 2nd century), exponent of Jain mysticism and Jain nayas
• Umāsvāti or Umasvami (c. 2nd century), author of first Jain work in Sanskrit Tattvārthasūtra

300–550 (Gupta Empire)

• Vasubandhu (c. 4th century) — one of the main founders of the Yogacara school
• Asanga (c. 4th century) — one of the main founders of the Yogacara school
• Bodhidharma (c. 440–528) — founder of Zen Buddhism
• Vatsyayana (c. 450–500) — author of commentary on Nyāya Sūtras and Kama Sutra
• Bhartrhari (450–510) — contributed to linguistic theory
• Buddhaghosa (c. 5th century)
• Siddhasena Divākara (c. 5th century) — Jain logician and author of important works in Sanskrit and Prakrit
• Dignāga (c. 5th century) — one of the Buddhist founders of Indian logic
• Śīlabhadra (c. 529-645) He is best known as being an abbot of Nālandā monastery in India, as being an expert on Yogācāra teachings, and for being the personal tutor of the Chinese Buddhist monk Xuanzang.
• Udyotakara Udyotakara (c. 6th–7th century) — Nyaya Philosopher

600–900 (Late Middle Kingdoms – The Classical Age)

• Candrakirti (born c. 600) — Madhyamaka Buddhist
• Kumārila Bhaṭṭa (c. 7th century) — Mimansa Philosopher
• Udyanacharya (c. 7th century) — Nyaya Philosopher
• Prabhākara (c. 7th century) — Grammarian and Mimansa Philosopher
• Dharmakirti (c. 7th century)
• Gaudapadacharya (c. 7th century) — Advaita Philosopher
• Adi Shankara (c. 788–820) — Advaita Vedanta school
• Anandavardhana (c. 820–890) — Philosopher of Aesthetics
• Vasugupta (860–925) — Author of Shiva Sutras
• Vācaspati Miśra (c. 9th century) — Nyaya Philosopher
• Jayanta Bhatta (c. 9th century) — Nyaya Philosopher

900–1100 (The Islamic Sultanates)

• Abhinavagupta (c. 975–1025)
• Atiśa (c. 980-1054) He was one of the major figures in the spread of Mahayana and Vajrayana Buddhism in Asia and inspired Buddhist thought from Tibet to Sumatra
• Udayana (c. 10th century) he was a very important Hindu logician who attempted to reconcile the views held by the two major schools of logic (Nyaya and Vaisheshika).
• Ramanuja (c. 1017–1137) — founder of Vishishtadvaita or Qualified Non-dualism

1100–1500 (Vijayanagara Empire and Delhi Sultanate)

• Gorakshanath (11th- to 12th-centuries)
• Basaveshwara (1134–1196) — founder of Lingayatism
• Shri Madhvacharya (1238–1317)
• Gangesa Upādhyāya (c. 13th century)
• Nimbarka (c. 13th century)
• Mādhava Vidyārānya (c. 1268–1386)
• Kabir (1440–1518)
• Vyasaṭīrtha (c. 1460–1539)
• Raghunatha Siromani (c. 1477–1547) — founder of Navya Nyāya philosophy
• Vallabhacharya (c. 1479–1531)
• Chaitanya Mahaprabhu (c. 1486–1534)
• Ravidas (1450–1520)

1500–1800 (Mughal Empire, Rajput Kingdoms and Maratha Confederacy Era)

• Mirabai (1498–1557) Bhakti saint & devotee of Krishna
• Nanak (c. 1469–1539) — Bhakti Philosopher, Founder of Sikhism
• Bhai gurdas :foundation sikh philosophy ,Indian six school interpretation
• Madhusūdana Sarasvatī (c. 1540–1640)
• Vijnānabhikṣu (c. 1550–1600) — synthesized Vedānta, Sāṅkhya, and Yoga into avibhagādvaita ("indistinguishable non-dualism")
• Gadadhara Bhattacharya (17th century) — Nyaya philosopher

Modern Indian philosophers

1800–1947 (Colonial and Postcolonial Era)

• Devendranath Tagore (1817–1905)
• Dayananda Saraswati (1824–1883) founder of ary samaj
• Sai Baba (1835–1918)
• Ramakrishna Paramahamsa (1836–1886)
• Swami Vivekananda (1863–1902)
• Krishna Chandra Bhattacharya(1875–1949) Phenomenology
• Narayana Guru (1856–1928)
• Rabindranath Tagore (1861–1941)
• Brajendranath Seal (1864–1938)
• Sri Aurobindo (1872–1950)
• Allama Iqbal (1877–1938)
• Ramana Maharshi (1879–1950)
• Nigamananda (1880–1935)
• Vinayak Damodar Savarkar (1883–1966)
• Gopinath Kaviraj (1887–1976)
• Sarvepalli Radhakrishnan (1888–1975)
• Nolini Kanta Gupta (1889–1983)
• Bhimrao Ramji Ambedkar (1891–1956)
• Jiddu Krishnamurti (1895–1986)
• A. C. Bhaktivedanta (1896–1977) — founder/acharya of ISKCON (Hare Krishna movement)
• Nisargadatta Maharaj (1897–1981)
• Haridas Chaudhuri (1913–1975)
• Deendayal Upadhyaya (1916–1968)
• U. G. Krishnamurti (1918–2007)
• Prabhat Ranjan Sarkar (1921–1990)
• Swami Krishnananda (1922–2001)
• Jitendra Nath Mohanty (1928–)
• Osho (1931–1990)
• Amartya Sen (born 1933)
• Bimal Krishna Matilal (1935–1991)
• Pandurang Shastri Athavale (1920–2003)

Japanese philosophers

Ancient Japanese philosophers

Until 1185 CE (until the end of the Heian period)

• Kūkai (774–835)
• Hōnen (1133–1212)

1185–1333 (Kamakura period)

• Shinran (1173–1261)
• Dōgen Zenji (1200–1253)
• Nichiren (1222–1282)

1333–1867 (Muromachi period to Edo period)

• Zeami Motokiyo (c. 1363 – c. 1443)
• Fujiwara Seika (1561–1619)
• Miyamoto Musashi (1584–1645)
• Kumazawa Banzan (1619–1691)
• Itō Jinsai (1627–1705)
• Kaibara Ekken (1630–1714)
• Ogyū Sorai (1666–1728)
• Hakuin Ekaku (1686–1769)
• Tominaga Nakamoto (1715–1746)
• Motoori Norinaga (1730–1801)
• Nishi Amane (1829–1897)

Modern Japanese philosophers

1867–1950

• Nishida Kitaro (1870–1945)
• D. T. Suzuki (1870–1966)
• Tanabe Hajime (1885–1962)
• Kuki Shūzō (1888–1941)
• Watsuji Tetsuro (1889–1960)
• Sakurazawa Yukikazu (George Ohsawa) (1893–1966)
• Miki Kiyoshi (1897–1945)
• Nishitani Keiji (1900–1990)

Korean philosophers

Ancient Korean philosophers

Until 676 CE (until the end of the Three Kingdoms period)

• Seungrang (c. 6th century)

676–935 (Unified Silla period)

• Woncheuk (613–696)
• Wonhyo (617–686)
• Uisang (625–702)
• Doseon (827–898)
• Choi Chi-won (b. 857)

935–1392 (Goryeo period)

• Uicheon (1055–1101)
• Jinul (1158–1210)

1392–1910 (Joseon period)

• Jeong Do-jeon (1342–1398)
• Seo Gyeong-deok (1489–1546)
• Yi Eon-jeok (1491–1553)
• Jo Sik (1501–1572)
• Yi Hwang (1501–1570)
• Yi I (1536–1584)
• Jeong Je-du (1649–1736)
• Jeong Yak-yong (1762–1836)
• Kim Jeong-hui (1786–1856)
• Choi Han-gi (1803–1879)
• Choi Je-u (1824–1864)
• Yi Je-ma (1838–1900)

Modern Korean philosophers

1910–1950

• Ryu Yeong-mo (1890–1981)
• Ham Seok-heon (1901–1989)

Tibetan philosophers

• Sakya Pandita (1182–1251)
• Rangjung Dorje (1284-1339)
• Dolpopa (Dol-bo-ba, 1292–1361)
• Longchenpa (1308–1364)
• Je Tsongkhapa (1357–1419)
• Gorampa (1429–1489)
• Sakya Chokden 1428–1507)
• Gyeltsap Darma Rinchen (1364–1432)
• Mikyö Dorje (1507–1554)
• Wangchuk Dorje (1556–1603)
• Jamyang Khyentse Wangpo (1820–1892)
• Jamgön Kongtrül (1813-1899)
• Jamgön Ju Mipham (1846–1912)

Timeline of World War I

1914
<table>
<thead>
<tr>
<th>Dates</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 28</td>
<td><strong>Assassination of Archduke Franz Ferdinand of Austria</strong>, heir to the Austro-Hungarian throne, who was killed in Sarajevo along with his wife Duchess Sophie by Gavrilo Princip, a Bosnian Serb.</td>
</tr>
<tr>
<td>July 5</td>
<td>Austria-Hungary seeks German support for a war against Serbia in case of Russian militarism. Germany gives assurances of support.</td>
</tr>
<tr>
<td>July 23</td>
<td>Beginning of the &quot;Black Week&quot;. Austria-Hungary sends an ultimatum to Serbia. The Serbian response is seen as satisfactory everywhere but in Vienna.</td>
</tr>
<tr>
<td>July 28</td>
<td>Austria-Hungary declares war on Serbia. The Netherlands declare neutrality.</td>
</tr>
<tr>
<td>July 29</td>
<td>Kaiser Wilhelm II of Germany and Czar Nicholas II of Russia communicate via telegram.</td>
</tr>
<tr>
<td>July 30</td>
<td>Germany sends Russia an ultimatum.</td>
</tr>
<tr>
<td>August 1</td>
<td>Germany declares war on Russia and mobilizes.</td>
</tr>
<tr>
<td></td>
<td>France mobilizes.</td>
</tr>
<tr>
<td></td>
<td>Italy declares its neutrality.</td>
</tr>
<tr>
<td></td>
<td>Denmark, Sweden and Norway unitedly declare their neutrality.</td>
</tr>
<tr>
<td></td>
<td>Germany and the Ottoman Empire sign a secret alliance treaty.</td>
</tr>
<tr>
<td>August 2</td>
<td>Germany invades Luxembourg.</td>
</tr>
<tr>
<td></td>
<td>Skirmish at Joncherey, first military action on the Western Front.</td>
</tr>
<tr>
<td>August 2–26</td>
<td>Germany besieges and captures fortified Longwy &quot;the iron gate to Paris&quot; near the Luxembourg border, opening France to mass German invasion.</td>
</tr>
<tr>
<td>August 3</td>
<td>Germany declares war on France. Belgium denies permission for German forces to pass through to the French border. Switzerland declares its neutrality and mobilizes for purposes of defense.</td>
</tr>
<tr>
<td>August 4</td>
<td>Germany invades Belgium to outflank the French army.</td>
</tr>
<tr>
<td></td>
<td>Britain protests against the violation of Belgian neutrality, guaranteed by the Treaty of London, The German Chancellor replies that the treaty is just a <em>chiffon de papier</em> (a scrap of paper). The United Kingdom declares war on Germany.</td>
</tr>
<tr>
<td></td>
<td>The United States declares neutrality.</td>
</tr>
<tr>
<td>August 4–16</td>
<td>Siege of Liège The Germans besiege and then capture the fortresses of Liège, Belgium.</td>
</tr>
<tr>
<td>August 5</td>
<td>German Steamer SS Pfálz surrenders after being fired on by Fort Nepean, south of Melbourne, Australia Montenegro declares war on Austria-Hungary. The Ottoman Empire closes the Dardanelles.</td>
</tr>
<tr>
<td>August 6</td>
<td>Austria-Hungary declares war on Russia. Serba declares war on Germany.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>August 7</td>
<td>Spain declares &quot;the strictest neutrality.&quot;</td>
</tr>
<tr>
<td>August 7–</td>
<td>Battle of the Frontiers. The Germans obtain a victory against the British Expeditionary Force and France's Fifth Army.</td>
</tr>
<tr>
<td>September 13</td>
<td></td>
</tr>
<tr>
<td>August 7–10</td>
<td>Battle of Mulhouse, a phase of the Battle of the Frontiers.</td>
</tr>
<tr>
<td>August 8</td>
<td>Montenegro declares war on Germany.</td>
</tr>
<tr>
<td>August 9</td>
<td>The Togoland Campaign begins.</td>
</tr>
<tr>
<td>August 11</td>
<td>France declares war on Austria-Hungary.</td>
</tr>
<tr>
<td>August 12</td>
<td>The United Kingdom declares war on Austria-Hungary.</td>
</tr>
<tr>
<td>August 14–25</td>
<td>Battle of Lorraine, a phase of the Battle of the Frontiers.</td>
</tr>
<tr>
<td>August 15</td>
<td>German troops crossed into British East Africa and occupied Taveta.</td>
</tr>
<tr>
<td>August 16–20</td>
<td>The Serbs defeat the Austro-Hungarians at the Battle of Cer.</td>
</tr>
<tr>
<td>August 17</td>
<td>The Russian army enters East Prussia. Battle of Stallupönen.</td>
</tr>
<tr>
<td>August 20</td>
<td>The Germans attack the Russians in East Prussia, the Battle of Gumbinnen. The attack is a failure in addition to being a deviation from the Schlieffen Plan.</td>
</tr>
<tr>
<td></td>
<td>The Germans occupy Brussels.</td>
</tr>
<tr>
<td></td>
<td>Battle of Morhange, a phase of the Battle of Lorraine.</td>
</tr>
<tr>
<td></td>
<td>Battle of Sarrebourg, a phase of the Battle of Lorraine.</td>
</tr>
<tr>
<td>August 21</td>
<td>Battle of Charleroi, a phase of the Battle of the Frontiers.</td>
</tr>
<tr>
<td>August 21–23</td>
<td>Battle of the Ardennes, a phase of the Battle of the Frontiers.</td>
</tr>
<tr>
<td>August 23</td>
<td>Japan declares war on Germany.</td>
</tr>
<tr>
<td></td>
<td>Battle of Mons, a phase of the Battle of the Frontiers.</td>
</tr>
<tr>
<td>August 23–30</td>
<td>Battle of Tannenberg: the Russian army undergoes a heavy defeat by the Germans.</td>
</tr>
<tr>
<td>August 23– September 11</td>
<td>Battle of Lemberg. The Russians capture Lviv.</td>
</tr>
<tr>
<td>August 24</td>
<td>Action of Elouges.</td>
</tr>
<tr>
<td></td>
<td>Battle of the Mortagne, a phase of the Battle of Lorraine.</td>
</tr>
<tr>
<td>August 24– September 7</td>
<td>The Germans besiege and capture the Maubeuge Fortress.</td>
</tr>
<tr>
<td>August 24– September 28</td>
<td>The Allied Great Retreat to the River Marne.</td>
</tr>
<tr>
<td>August 25</td>
<td>Japan declares war on Austria-Hungary.</td>
</tr>
<tr>
<td></td>
<td>Battle of Tepe: The Kamerun Campaign begins.</td>
</tr>
<tr>
<td>August 26</td>
<td>British and French forces conquer Togoland, a German protectorate in West Africa.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>-----------</td>
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</tr>
<tr>
<td>August 26–27</td>
<td>Battle of Le Cateau. Allied retreat.</td>
</tr>
<tr>
<td>August 26–30</td>
<td>Battle of Gnila Lipa, a phase of the Battle of Lemberg.</td>
</tr>
<tr>
<td>August 26 – September 2</td>
<td>Battle of Komarow, part of the Battle of Lemberg.</td>
</tr>
<tr>
<td>August 26 - February 18, 1916</td>
<td>Siege of Mora.</td>
</tr>
<tr>
<td>August 27</td>
<td>Battle of Étreux.</td>
</tr>
<tr>
<td>August 27 – November 7</td>
<td>Battle of Tsingtao: British and Japanese forces capture the German-controlled port of Tsingtao in China.</td>
</tr>
<tr>
<td>August 28</td>
<td>The Royal Navy wins the First Battle of Heligoland Bight, North Sea.</td>
</tr>
<tr>
<td>August 29</td>
<td>Austria-Hungary declares war on Belgium.</td>
</tr>
<tr>
<td>August 29–30</td>
<td>Battle of Saint Quentin, also known as Battle of Guise. Orderly Allied retreat.</td>
</tr>
<tr>
<td>August 29–31</td>
<td>First Battle of Garua.</td>
</tr>
<tr>
<td>August 30</td>
<td>New Zealand occupies German Samoa (later Western Samoa).</td>
</tr>
<tr>
<td>September 1</td>
<td>Action at Nery</td>
</tr>
<tr>
<td>September 2–11</td>
<td>Austro-Hungarian defeat at the Battle of Rava Russka, a phase of the Battle of Lemberg.</td>
</tr>
<tr>
<td>September 5</td>
<td>British Ship HMS Pathfinder (1904) is sunk by a German U-Boat</td>
</tr>
<tr>
<td>September 5–12</td>
<td>First Battle of the Marne. The German advance on Paris is halted, marking the failure of the Schlieffen Plan.</td>
</tr>
<tr>
<td>September 6</td>
<td>Battle of Nsanakong.</td>
</tr>
<tr>
<td>September 6–12</td>
<td>Battle of the Marshes of Saint-Gond, a phase of the First Battle of the Marne.</td>
</tr>
<tr>
<td>September 6–October 4</td>
<td>Battle of Drina.</td>
</tr>
<tr>
<td>September 7</td>
<td>Fanning Raid.</td>
</tr>
<tr>
<td>September 7–14</td>
<td>First Battle of the Masurian Lakes: The Russian Army of the Neman withdraws from East Prussia with heavy casualties.</td>
</tr>
<tr>
<td>September 9</td>
<td>Theobald von Bethmann Hollweg lays out Germany's war aims.</td>
</tr>
<tr>
<td>September 11</td>
<td>Battle of Bita Paka.</td>
</tr>
<tr>
<td>September 13</td>
<td>Troops from South Africa begin invading German South-West Africa.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>September 13–28</td>
<td>The First Battle of the Aisne ends in a substantial draw. The <em>Race to the Sea</em> begins.</td>
</tr>
<tr>
<td>September 14</td>
<td>Erich von Falkenhayn replaces Helmuth von Moltke the Younger as German Chief of Staff.</td>
</tr>
<tr>
<td>September 14–17</td>
<td>Siege of Toma. Most German forces in New Guinea surrender to the Australians then or over the following year.</td>
</tr>
<tr>
<td>September 15</td>
<td>Boer leader Manie Maritz revolts in South Africa.</td>
</tr>
<tr>
<td>September 19 – October 11</td>
<td>Battle of Flirey</td>
</tr>
<tr>
<td>September 20</td>
<td>Battle of Zanzibar, German naval victory.</td>
</tr>
<tr>
<td>September 22</td>
<td>Bombardment of Papeete</td>
</tr>
<tr>
<td>September 22–26</td>
<td>German Light Cruiser Emden attacks Madras</td>
</tr>
<tr>
<td>September 24</td>
<td>The Siege of Przemyśl begins</td>
</tr>
<tr>
<td>September 26</td>
<td>Battle of Sandfontein.</td>
</tr>
<tr>
<td>September 25–29</td>
<td>First Battle of Albert</td>
</tr>
<tr>
<td>September 28 – October 10</td>
<td>The Germans besiege and capture Antwerp, Belgium.</td>
</tr>
<tr>
<td>September 29–30</td>
<td>Japan occupies the Marshall Islands.</td>
</tr>
<tr>
<td>September 29 – October 31</td>
<td>Battle of the Vistula River, also known as Battle of Warsaw.</td>
</tr>
<tr>
<td>October 10 – November 2</td>
<td>Central powers control Belgrade.</td>
</tr>
<tr>
<td>October 12 – November 2</td>
<td>First Battle of Messines.</td>
</tr>
<tr>
<td>October 13 – November 2</td>
<td>Battle of Armentieres.</td>
</tr>
<tr>
<td>October 16–31</td>
<td>Battle of the Yser. French and Belgian forces secure the coastline of Belgium.</td>
</tr>
<tr>
<td>October 19</td>
<td>The First Battle of Ypres ends the <em>Race to the Sea</em>. The Germans are prevented from reaching</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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<td>---------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>November 22</td>
<td>Calais and Dunkirk.</td>
</tr>
<tr>
<td>October 19 -</td>
<td></td>
</tr>
<tr>
<td>July 7, 1915</td>
<td>Clashes between German and Portuguese forces in the Angola-Namibia</td>
</tr>
<tr>
<td></td>
<td>border, without declaration of war.</td>
</tr>
<tr>
<td>October 28</td>
<td>Battle of Penang.</td>
</tr>
<tr>
<td>October 29</td>
<td>Black Sea Raid. Ottoman warships bombard the Russian ports of Odessa</td>
</tr>
<tr>
<td></td>
<td>and Sevastopol.</td>
</tr>
<tr>
<td>November 1</td>
<td>Russia declares war on the Ottoman Empire.</td>
</tr>
<tr>
<td></td>
<td>Battle of Coronel. Von Spee's German cruiser squadron defeats a Royal</td>
</tr>
<tr>
<td></td>
<td>Navy squadron under Christopher Cradock.</td>
</tr>
<tr>
<td>November 2</td>
<td>The United Kingdom begins the naval blockade of Germany.</td>
</tr>
<tr>
<td></td>
<td>Serbia declares war on the Ottoman Empire.</td>
</tr>
<tr>
<td>November 2–16</td>
<td>Bergmann Offensive, first military engagement in the Caucasus of the</td>
</tr>
<tr>
<td></td>
<td>First World War.</td>
</tr>
<tr>
<td>November 3</td>
<td>Montenegro declares war on the Ottoman Empire.</td>
</tr>
<tr>
<td></td>
<td>Battle of Kilimanjaro.</td>
</tr>
<tr>
<td>November 3–5</td>
<td>Von Lettow-Vorbeck's German colonial forces defeat the British at the</td>
</tr>
<tr>
<td></td>
<td>Battle of Tanga, German East Africa.</td>
</tr>
<tr>
<td>November 5</td>
<td>France and the United Kingdom declare war on the Ottoman Empire.</td>
</tr>
<tr>
<td>November 6</td>
<td>Fao Landing, British and Indians besiege the fortress at Fao.</td>
</tr>
<tr>
<td>November 7</td>
<td>Japanese Forces capture the Naval Base at Tsingtao.</td>
</tr>
<tr>
<td>November 11</td>
<td>Sultan Mehmmed V declares Jihad on the Allies.</td>
</tr>
<tr>
<td>November 11–</td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Battle of Basra.</td>
</tr>
<tr>
<td>November 11–</td>
<td></td>
</tr>
<tr>
<td>December 6</td>
<td>Battle of Łódź (also known as Silesian Offensive).</td>
</tr>
<tr>
<td>November 13</td>
<td>Battle of El Herri: Worst French defeat in Morocco at the hands of</td>
</tr>
<tr>
<td></td>
<td>the Zayanes.</td>
</tr>
<tr>
<td>November 16–</td>
<td></td>
</tr>
<tr>
<td>December 15</td>
<td>Battle of Kolubara, Austro-Hungarians leave Serbia.</td>
</tr>
<tr>
<td>November 19</td>
<td>Bolshevik representatives at the State Duma arrested and exiled to</td>
</tr>
<tr>
<td></td>
<td>Siberia.</td>
</tr>
<tr>
<td>November 23</td>
<td>Basra is occupied by the British.</td>
</tr>
<tr>
<td>December 1–13</td>
<td>Battle of Limanowa.</td>
</tr>
<tr>
<td>December 3–9</td>
<td>Battle of Qurna.</td>
</tr>
<tr>
<td>December 8</td>
<td>Battle of the Falklands. Von Spee's German cruiser squadron is</td>
</tr>
<tr>
<td></td>
<td>defeated by the Royal Navy.</td>
</tr>
<tr>
<td>December 10</td>
<td>Hill 60 captured by the Germans.</td>
</tr>
<tr>
<td>December 14</td>
<td>Ottomans occupy the Persian border town of Qotur as a bridgehead to</td>
</tr>
<tr>
<td></td>
<td>the Caucasus, but withdraw after their defeat at Sarikamish.</td>
</tr>
<tr>
<td>December 16</td>
<td>The German fleet shells Scarborough, Hartlepool, and Whitby England.</td>
</tr>
<tr>
<td>December 18–22</td>
<td>Battle of Givenchy.</td>
</tr>
<tr>
<td>Dates</td>
<td>Events</td>
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<td>---------------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>December 17 –</td>
<td>First Battle of Artois.</td>
</tr>
<tr>
<td>January 13, 1915</td>
<td></td>
</tr>
<tr>
<td>December 20</td>
<td>Fighting begins at Perthes.</td>
</tr>
<tr>
<td>December 20 –</td>
<td>First Battle of Champagne.</td>
</tr>
<tr>
<td>17 March 1915</td>
<td></td>
</tr>
<tr>
<td>December 22</td>
<td>Fighting begins at Noyon.</td>
</tr>
<tr>
<td>December 22 –</td>
<td>The Russians win the Battle of Sarikamish, Caucasus.</td>
</tr>
<tr>
<td>January 2, 1915</td>
<td></td>
</tr>
<tr>
<td>December 24–25</td>
<td>In some sectors of the Western Front, an unofficial Christmas truce is</td>
</tr>
<tr>
<td></td>
<td>observed between German and British forces.</td>
</tr>
<tr>
<td>December 25 –</td>
<td>Battle of Ardahan.</td>
</tr>
<tr>
<td>January 18, 1915</td>
<td></td>
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</tbody>
</table>

**1915**

<table>
<thead>
<tr>
<th>Dates</th>
<th>Events</th>
</tr>
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<tbody>
<tr>
<td>January 2</td>
<td>The Russian offensive in the Carpathians begins. It will continue until</td>
</tr>
<tr>
<td></td>
<td>April 12.</td>
</tr>
<tr>
<td>January 4–11</td>
<td>Ottomans occupy Urmia and Tabriz by surprise.</td>
</tr>
<tr>
<td>January 8</td>
<td>Japan attempts to impose its Twenty-One Demands on neutral China.</td>
</tr>
<tr>
<td>January 18–19</td>
<td>Battle of Jassin.</td>
</tr>
<tr>
<td>January 19</td>
<td>First Zeppelin raid on Great Britain.</td>
</tr>
<tr>
<td>January 19 – December</td>
<td>Battle of Hartmannswillerkopf, series of battles fought to control</td>
</tr>
<tr>
<td>22</td>
<td>the peak.</td>
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<tr>
<td>January 24</td>
<td>Battle of Dogger Bank between squadrons of the British <em>Grand Fleet</em></td>
</tr>
<tr>
<td></td>
<td>and the German <em>Hochseeflotte</em>.</td>
</tr>
<tr>
<td>January 24–26</td>
<td>Chilembwe uprising led by John Chilembwe in Nyasaland.</td>
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<tr>
<td>January 28 – February</td>
<td>The Ottomans fail to capture the Suez Canal.</td>
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<td></td>
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<tr>
<td>January 30</td>
<td>The Russians take Tabriz.</td>
</tr>
<tr>
<td>January 31</td>
<td>Battle of Bolimov. First German use of chemical weapons.</td>
</tr>
<tr>
<td>February 4</td>
<td>Germany begins unrestricted submarine warfare against merchant vessels.</td>
</tr>
<tr>
<td></td>
<td>Jan Kemp surrenders. End of the Maritz Rebellion.</td>
</tr>
<tr>
<td></td>
<td>Battle of Kakamas: German invasion of South Africa repelled.</td>
</tr>
<tr>
<td>February 7–22</td>
<td>Second Battle of the Masurian Lakes. The Russian X Army is defeated.</td>
</tr>
<tr>
<td>February 15</td>
<td>Troops in Singapore mutiny against the British</td>
</tr>
<tr>
<td>February 19</td>
<td>British and French naval attack on the Dardanelles. The Gallipoli</td>
</tr>
<tr>
<td></td>
<td>Campaign begins.</td>
</tr>
<tr>
<td>March 5</td>
<td>Great Britain and France promise Russia Constantinople.</td>
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<tr>
<td>March 7</td>
<td>Ottomans retreat to Qotur, pushed by a Russian counteroffensive.</td>
</tr>
<tr>
<td>Date Range</td>
<td>Event</td>
</tr>
<tr>
<td>-------------------------</td>
<td>---------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>March 10 – March 13</td>
<td>Battle of Neuve Chapelle. After an initial success, a British offensive is halted.</td>
</tr>
<tr>
<td>March 14</td>
<td>Battle of Más a Tierra. The last remnant of the German East Asia Squadron is sunk and its crew interned in neutral Chile.</td>
</tr>
<tr>
<td>March 18</td>
<td>Battle of 18 March. The British and French unsuccessfully try to force the Dardanelles, losing 3 Pre-Dreadnought Battleships</td>
</tr>
<tr>
<td>March 22</td>
<td>The Siege of Przemysł ends. The Russians capture the fortress.</td>
</tr>
<tr>
<td>April 5 – May 5</td>
<td>First Battle of Woevre.</td>
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<tr>
<td>April 12–14</td>
<td>Battle of Shaiba.</td>
</tr>
<tr>
<td>April 15</td>
<td>Battle of Dilman</td>
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<tr>
<td>April 19 – May 17</td>
<td>The Ottomans besiege the Armenian city of Van.</td>
</tr>
<tr>
<td>April 22 – May 25</td>
<td>The Second Battle of Ypres, which ends in a stalemate. Germany first uses poison gas.</td>
</tr>
<tr>
<td>April 22–23</td>
<td>Battle of Gravenstafel, First stage of the Second Battle of Ypres.</td>
</tr>
<tr>
<td>April 24</td>
<td>Deportation of Armenian intellectuals to Ankara, first act of the Armenian Genocide.</td>
</tr>
<tr>
<td>April 24 – May 5</td>
<td>Battle of St Julien, part of the Second Battle of Ypres.</td>
</tr>
<tr>
<td>April 25</td>
<td>Allied forces land on Gallipoli, landing at Anzac Cove and Cape Helles.</td>
</tr>
<tr>
<td>April 26</td>
<td>Treaty of London between the Entente and Italy.</td>
</tr>
<tr>
<td></td>
<td>Battle of Trekkopjes.</td>
</tr>
<tr>
<td>April 28</td>
<td>First Battle of Krithia. The Allied advance is repelled.</td>
</tr>
<tr>
<td>April 29</td>
<td>Battle of Gurin.</td>
</tr>
<tr>
<td>May 1</td>
<td>The Gorlice-Tarnów Offensive begins: the German troops under General Mackensen break through the Russian lines in Galicia.</td>
</tr>
<tr>
<td></td>
<td>Battle of Eski Hissarlik.</td>
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<tr>
<td>May 3</td>
<td>Troops withdraw from Anzac Cove.</td>
</tr>
<tr>
<td></td>
<td>Italy revokes its commitment to a defensive alliance with Germany and Austria-Hungary.</td>
</tr>
<tr>
<td>May 6–8</td>
<td>Second Battle of Krithia. The Allied attempts at advancing are thwarted again.</td>
</tr>
<tr>
<td>May 7</td>
<td>The British liner <em>Lusitania</em> is sunk by a German U-boat.</td>
</tr>
<tr>
<td>May 9 – June 18</td>
<td>Second Battle of Artois.</td>
</tr>
<tr>
<td>May 9</td>
<td>Battle of Aubers Ridge, a phase of the Second Battle of Artois.</td>
</tr>
<tr>
<td>May 10</td>
<td>Troops from Hungary rout the Russians at Jaroslaw. Lviv is again in Austrian hands.</td>
</tr>
<tr>
<td>May 11</td>
<td>Armistice called at Gallipoli to bury the dead.</td>
</tr>
<tr>
<td>May 12</td>
<td>Windhoek, capital of German South-West Africa, is occupied by South African troops.</td>
</tr>
<tr>
<td>May 15–25</td>
<td>Battle of Festubert.</td>
</tr>
<tr>
<td>May 16 – June 23</td>
<td>Battle of Konary.</td>
</tr>
<tr>
<td>May 23</td>
<td>Italy declares war on Austria-Hungary.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>May 24–25</td>
<td>Battle of Bellewaarde, final phase of the Second Battle of Ypres.</td>
</tr>
<tr>
<td>May 31 - June 10</td>
<td>Second Battle of Garua.</td>
</tr>
<tr>
<td>June–September</td>
<td>The Russian Great Retreat from Poland and Galicia.</td>
</tr>
<tr>
<td>June 4</td>
<td>Third Battle of Krithia. Yet another Allied failure.</td>
</tr>
<tr>
<td></td>
<td>The Russians leave Przemyśl.</td>
</tr>
<tr>
<td>June 21–23</td>
<td>Battle of Bukoba.</td>
</tr>
<tr>
<td>June 22</td>
<td>Mackensen breaks again through the Russian lines in the Lviv area.</td>
</tr>
<tr>
<td>June 23 – July 7</td>
<td>First Battle of the Isonzo.</td>
</tr>
<tr>
<td>June 27</td>
<td>The Austro-Hungarians re-enter Lviv.</td>
</tr>
<tr>
<td>June 28 – July 5</td>
<td>The British win the Battle of Gully Ravine.</td>
</tr>
<tr>
<td>June 29</td>
<td>Battle of Ngaundere</td>
</tr>
<tr>
<td>July 1</td>
<td>First aerial victory by a synchronized gun-armed fighter aircraft</td>
</tr>
<tr>
<td></td>
<td>Battle of Otavi.</td>
</tr>
<tr>
<td>July 9</td>
<td>The German forces in South-West Africa surrender.</td>
</tr>
<tr>
<td>July 10–26</td>
<td>Battle of Manzikert.</td>
</tr>
<tr>
<td>July 18 – August 3</td>
<td>Second Battle of the Isonzo.</td>
</tr>
<tr>
<td>July 25</td>
<td>Italians capture Cappuccio Wood.</td>
</tr>
<tr>
<td></td>
<td>First Victoria Cross awarded to a British combat pilot</td>
</tr>
<tr>
<td>July 27–31</td>
<td>Battle of Kara Killisse.</td>
</tr>
<tr>
<td>August 5</td>
<td>The Germans occupy Warsaw.</td>
</tr>
<tr>
<td>August 6–10</td>
<td>Battle of Lone Pine, part of the August Offensive.</td>
</tr>
<tr>
<td>August 6–13</td>
<td>Battle of Krithia Vineyard, part of the August Offensive.</td>
</tr>
<tr>
<td>August 6–15</td>
<td>Allies land at Suvla Bay, a phase of the August Offensive.</td>
</tr>
<tr>
<td>August 6–21</td>
<td>Battle of Sari Bair, part of the August Offensive. Last and unsuccesful attempt by the British to seize the Gallipoli peninsula.</td>
</tr>
<tr>
<td>August 7</td>
<td>Battle of the Nek, a phase of the August Offensive.</td>
</tr>
<tr>
<td>August 7–19</td>
<td>Battle of Chunuk Bair, a phase of the August Offensive.</td>
</tr>
<tr>
<td>August 19</td>
<td>A German U-Boat sinks the liner SS Arabic (1902). 44 died including 3 Americans</td>
</tr>
<tr>
<td>August 21</td>
<td>Scimitar Hill, a phase of the August Offensive. Italy declares war on the Ottoman Empire.</td>
</tr>
<tr>
<td>August 21–29</td>
<td>Battle of Hill 60, part of the August Offensive.</td>
</tr>
<tr>
<td>August 26 – September 19</td>
<td>Sventiany Offensive, a phase of the Gorlice-Tarnow Offensive.</td>
</tr>
<tr>
<td>September 1</td>
<td>Germany suspends unrestricted submarine warfare.</td>
</tr>
<tr>
<td>September 5–8</td>
<td>The Zimmerwald Conference of anti-militarist European socialist parties is held in Zimmerwald, Switzerland.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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<td>--------------------</td>
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</tr>
<tr>
<td>September 5</td>
<td>Nicholas II removes Grand Duke Nicholas Nikolayevich as Commander-in-Chief of the Russian Army, personally taking that position.</td>
</tr>
<tr>
<td>September 15 –</td>
<td>Third Battle of Artois.</td>
</tr>
<tr>
<td>September 25 –</td>
<td>Battle of Loos, a major British offensive, fails.</td>
</tr>
<tr>
<td>October 15</td>
<td>Battle of the Hohenzollern Redoubt, a phase of the Battle of Loos.</td>
</tr>
<tr>
<td>September 25 –</td>
<td>Second Battle of Champagne.</td>
</tr>
<tr>
<td>November 6</td>
<td>Battle of Es Sinn.</td>
</tr>
<tr>
<td>September 28</td>
<td>Allies land troops at Salonika in Greece to aid Serbia.</td>
</tr>
<tr>
<td>October 3</td>
<td>Serbia is invaded by Germany, Austria-Hungary, and Bulgaria.</td>
</tr>
<tr>
<td>October 7 –</td>
<td>Edith Cavell executed.</td>
</tr>
<tr>
<td>December 4</td>
<td>Bulgaria declares war on Serbia</td>
</tr>
<tr>
<td>October 14 –</td>
<td>Morava Offensive, a phase of the Central Powers Invasion of Serbia, Bulgarians break through Serbian lines.</td>
</tr>
<tr>
<td>November 9</td>
<td>Ovche Pole Offensive, a phase of the Central Powers invasion of Serbia, Bulgarians break through Serbian lines.</td>
</tr>
<tr>
<td>October 14</td>
<td>The United Kingdom declares war on Bulgaria.</td>
</tr>
<tr>
<td>October 12</td>
<td>Montenegro declares war on Bulgaria.</td>
</tr>
<tr>
<td>October 14 –</td>
<td>France declares war on Bulgaria.</td>
</tr>
<tr>
<td>November 9</td>
<td>Battle of Krivolak, first of the Salonika Front.</td>
</tr>
<tr>
<td>October 15</td>
<td>Third Battle of the Isonzo</td>
</tr>
<tr>
<td>October 18 –</td>
<td>Italy and Russia declare war on Bulgaria.</td>
</tr>
<tr>
<td>November 4–6</td>
<td>Andrew Fisher resigns as Prime Minister of Australia; he is replaced by Billy Hughes.</td>
</tr>
<tr>
<td>November 10</td>
<td>René Viviani resigns as Prime Minister of France; he is replaced by Aristide Briand.</td>
</tr>
<tr>
<td>November 10 –</td>
<td>Pro-Central Powers Iranians seize Shiraz from pro-Entente forces and arrest all British citizens in the city.</td>
</tr>
<tr>
<td>December 2</td>
<td>Fourth Battle of the Isonzo</td>
</tr>
<tr>
<td>November 10 –</td>
<td>Kosovo Offensive, a phase of the Central Powers invasion of Serbia, Serbians pushed into Albania.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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<tr>
<td>November 14–30</td>
<td>Russian forces from the Caucasus occupy Tehran.</td>
</tr>
<tr>
<td>November 17</td>
<td>Armed by Ottomans and Germans, the Libyan Senussi cross the border and attack Egypt from the west.</td>
</tr>
<tr>
<td>November 22–25</td>
<td>Battle of Ctesiphon, in present-day Iraq.</td>
</tr>
<tr>
<td>November 27</td>
<td>The Serbian army collapses. It will retreat to the Adriatic Sea and be evacuated by the Italian and French Navies.</td>
</tr>
<tr>
<td>December 6–12</td>
<td>Battle of Kosturino</td>
</tr>
<tr>
<td>December 7</td>
<td>The First Siege of Kut, Mesopotamia, by the Ottomans begins.</td>
</tr>
<tr>
<td>December 15</td>
<td>Russians occupy Hamadan.</td>
</tr>
<tr>
<td>December 18</td>
<td>Gallipoli evacuations, a major Ottoman victory and a &quot;disaster for the Allies.&quot;</td>
</tr>
<tr>
<td>December 19</td>
<td>Douglas Haig replaces John French as commander of the British Expeditionary Force.</td>
</tr>
<tr>
<td>December 23</td>
<td>Carl Zimmermann orders the retreat of all German forces and civilians in Kamerun to the Spanish colony of Rio Muni.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Dates</th>
<th>Events</th>
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<tbody>
<tr>
<td>1916</td>
<td>January 5–17</td>
<td>Austro-Hungarian offensive against Montenegro, which capitulates.</td>
</tr>
<tr>
<td></td>
<td>January 6–7</td>
<td>Battle of Mojkovac</td>
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<td></td>
<td>January 6–8</td>
<td>Battle of Sheikh Sa'ad, a phase of the First Siege of Kut.</td>
</tr>
<tr>
<td></td>
<td>January 9</td>
<td>The Gallipoli Campaign ends in an Allied defeat and an Ottoman victory.</td>
</tr>
<tr>
<td></td>
<td>January 10 – February 16</td>
<td>Battle of Erzurum.</td>
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<td></td>
<td>January 11</td>
<td>Corfu occupied by the Allies.</td>
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<tr>
<td></td>
<td>January 13</td>
<td>Battle of Wadi, a phase of the First Siege of Kut.</td>
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<tr>
<td></td>
<td>January 21</td>
<td>Battle of Hanna, a phase of the First Siege of Kut.</td>
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<tr>
<td></td>
<td>January 24</td>
<td>Reinhard Scheer is appointed commander of Germany's Hochseeflotte.</td>
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<td></td>
<td>January 27</td>
<td>Conscription introduced in the United Kingdom by the Military Service Act 1916.</td>
</tr>
<tr>
<td></td>
<td>February 5 – April 15</td>
<td>Trebizond Campaign.</td>
</tr>
<tr>
<td></td>
<td>February 12</td>
<td>Battle of Salaita Hill.</td>
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<td></td>
<td>February 21</td>
<td>The Battle of Verdun begins.</td>
</tr>
<tr>
<td></td>
<td>February 26</td>
<td>Battle of Agagia: Senussi rebellion suppressed by the British.</td>
</tr>
<tr>
<td></td>
<td>February 28</td>
<td>German Kamerun (Cameroon) surrenders.</td>
</tr>
<tr>
<td></td>
<td>March 1</td>
<td>Germany resumes unrestricted submarine warfare.</td>
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<tr>
<td></td>
<td>March 1–15</td>
<td>Fifth Battle of the Isonzo.</td>
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<tr>
<td>Date Range</td>
<td>Event Description</td>
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<tr>
<td>March 2 – August 4</td>
<td>Battle of Bitlis.</td>
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<tr>
<td>March 8</td>
<td>Battle of Dujaila: a British attempt to relieve Kut failed.</td>
<td></td>
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<tr>
<td>March 9</td>
<td>Germany declares war on Portugal. Portugal officially enters the war.</td>
<td></td>
</tr>
<tr>
<td>March 11–12</td>
<td>Battle of Latema Nek.</td>
<td></td>
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<tr>
<td>March 14</td>
<td>The Manifesto of the Sixteen, declaring Kropotkinist-anarchist support of the Allied war effort, is published.</td>
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</tr>
<tr>
<td>March 15</td>
<td>Austria-Hungary declares war on Portugal.</td>
<td></td>
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<tr>
<td>March 16 - November 6</td>
<td>British preemptively occupy the Sultanate of Darfur and annex it to the Anglo-Egyptian Sudan.</td>
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<tr>
<td>March 18</td>
<td>Battle of Kahe.</td>
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<tr>
<td>March 18 – April</td>
<td>Lake Naroch Offensive.</td>
<td></td>
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<tr>
<td>April 24–29</td>
<td>Easter Rising by Irish rebels for independence from the United Kingdom.</td>
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</tr>
<tr>
<td>April 24–30</td>
<td>The Kienthal Conference, the second meeting of the anti-war socialist Zimmerwald Movement, is held in Kienthal, Switzerland.</td>
<td></td>
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<tr>
<td>April 27–29</td>
<td>Gas attacks at Hulluch.</td>
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<tr>
<td>April 29</td>
<td>The British forces under siege at Kut surrender to the Ottomans, first siege of Kut ends.</td>
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<tr>
<td>May 7–10</td>
<td>Battle of Kondoa Irangi.</td>
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<tr>
<td>May 10</td>
<td>Germany suspends unrestricted submarine warfare.</td>
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<tr>
<td>May 16</td>
<td>Signing of the Sykes-Picot Agreement between Britain and France defining their proposed spheres in the Middle East.</td>
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<tr>
<td>May 18</td>
<td>Russian forces in Persia link up with the British in Mesopotamia, but it is too late.</td>
<td></td>
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<tr>
<td>May 31 – June 1</td>
<td>Battle of Jutland between Britain's Grand Fleet and Germany's Hochseeflotte.</td>
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<tr>
<td>June 2–14</td>
<td>Battle of Mont Sorrel.</td>
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<tr>
<td>June 3</td>
<td>Russians fail to encircle Ottoman forces in Persia.</td>
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<tr>
<td>June 4</td>
<td>The Brusilov Offensive begins.</td>
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<tr>
<td>June 5</td>
<td>The Arab Revolt in Hejaz begins.</td>
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<td></td>
<td>HMS Hampshire is sunk off the Orkney Islands; Lord Kitchener dies.</td>
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<tr>
<td>June 8</td>
<td>In the Adriatic Sea the Italian troopship SS Principe Umberto is sunk by an Austro-Hungarian submarine. It is the deadliest sinking of the war, with 1,900 lives lost.</td>
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<tr>
<td>June 10</td>
<td>Italy: Paolo Boselli succeeds Antonio Salandra as Prime Minister.</td>
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<tr>
<td></td>
<td>The Siege of Medina begins.</td>
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<tr>
<td>Date</td>
<td>Event</td>
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<tr>
<td>June 10 – July 4</td>
<td>Battle of Mecca, Arabs capture the city.</td>
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<tr>
<td>June 12</td>
<td>Percy Sykes marches on Kerman to link up with the Russian forces in central-northern Persia.</td>
<td></td>
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<tr>
<td>June 30</td>
<td>Battle of the Boar's Head, diversion from the Battle of the Somme which began the next day.</td>
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<tr>
<td>July</td>
<td>Battle of Taif.</td>
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<tr>
<td>July 1</td>
<td>The Battle of the Somme begins.</td>
<td></td>
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<tr>
<td>July 1–3</td>
<td>The Social Democratic Party wins a majority in the parliament of the Russian-ruled Grand Duchy of Finland.</td>
<td></td>
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<tr>
<td>July 1–13</td>
<td>Second Battle of Albert (Opening phase of the Battle of the Somme).</td>
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<tr>
<td>July 1–2</td>
<td>British capture Fricourt during the Second Battle of Albert.</td>
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<tr>
<td>July 2</td>
<td>Ottoman counter-attack into Persia reaches Kermanshah.</td>
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<tr>
<td>July 2–25</td>
<td>Battle of Erzincan.</td>
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<tr>
<td>July 3–7</td>
<td>British capture La Boisselle during the Second Battle of Albert.</td>
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<tr>
<td>July 3–12</td>
<td>British capture Mametz Wood during the Second Battle of Albert.</td>
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<tr>
<td>July 3–17</td>
<td>British capture Ovillers during the Second Battle of Albert and Battle of Bazentin Ridge.</td>
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<tr>
<td>July 4–6</td>
<td>Battle of Kostiuchnowka.</td>
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<tr>
<td>July 7–11</td>
<td>British capture Contalmaison during the Second Battle of Albert.</td>
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<tr>
<td>July 8–14</td>
<td>British capture Trônes Wood during the Second Battle of Albert.</td>
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<tr>
<td>July 14–17</td>
<td>Battle of Bazentin Ridge (Initial phase of the Battle of the Somme)</td>
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<tr>
<td>July 14 – September 15</td>
<td>Battles for Longueval and Delville Wood (Initial phase of the Battle of the Somme)</td>
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<tr>
<td>July 19–20</td>
<td>Battle of Fromelles (Initial phase of the Battle of the Somme).</td>
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<tr>
<td>July 23 – August 7</td>
<td>Battle of Pozières (Initial phase of the Battle of the Somme)</td>
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<tr>
<td>July 24 – August 8</td>
<td>Battle of Kowel.</td>
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<tr>
<td>July 30</td>
<td>German agents sabotage munition factories in Jersey City that supply the Allies, causing the Black Tom explosion.</td>
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<tr>
<td>August 3–5</td>
<td>Battle of Romani. Ottoman attack on the British in the Sinai peninsula fails.</td>
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<tr>
<td>August 6–17</td>
<td>Sixth Battle of the Isonzo. The Italians capture Gorizia (August 9).</td>
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<tr>
<td>August 6</td>
<td>Battle of Doberdo, part of the Sixth Battle of Isonzo.</td>
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<tr>
<td>August 9–18</td>
<td>First battle of Doiran.</td>
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<tr>
<td>August 10</td>
<td>Ottomans take Hamadan.</td>
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<tr>
<td>August 24</td>
<td>Battle of Mlali.</td>
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<tr>
<td>August 27</td>
<td>Romania enters the war on the Entente's side. Her army is defeated in a few weeks.</td>
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<tr>
<td>August 27 –</td>
<td>Conquest of Romania by Central Powers.</td>
<td></td>
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<tr>
<td>Date</td>
<td>Event</td>
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<tr>
<td>December</td>
<td>Battle of Transylvania, a phase of the conquest of Romania.</td>
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<tr>
<td>August 27 - November 26</td>
<td>Italy declares war on Germany.</td>
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<tr>
<td>August 28</td>
<td>Paul von Hindenburg replaces Erich von Falkenhayn as German Chief of Staff.</td>
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<tr>
<td>August 29</td>
<td>The Ottoman Empire declares war on Romania.</td>
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<tr>
<td>September 1</td>
<td>Bulgaria declares war on Romania.</td>
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<tr>
<td>September 2–6</td>
<td>Battle of Turtucaia, a phase of the conquest of Romania.</td>
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<tr>
<td>September 3–6</td>
<td>Battle of Guillemont (intermediate phase of the Battle of the Somme)</td>
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<tr>
<td>September 5–7</td>
<td>Battle of Dobrich, a phase of the conquest of Romania.</td>
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<tr>
<td>September 6</td>
<td>The Central Powers create a unified command.</td>
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<tr>
<td>September 7–11</td>
<td>Battle of Kisaki.</td>
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<tr>
<td>September 8–19</td>
<td>Battle of Tabora.</td>
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<tr>
<td>September 9</td>
<td>Battle of Ginchy (intermediate phase of the Battle of the Somme)</td>
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<tr>
<td>September 9–11</td>
<td>Battle of Dutumi.</td>
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<tr>
<td>September 12 – December 11</td>
<td>Monastir Offensive, set up of the Salonika Front.</td>
<td></td>
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<tr>
<td>September 12–14</td>
<td>Battle of Malka Nidzhe, a phase of the Monastir Offensive.</td>
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<tr>
<td>September 12–30</td>
<td>Battle of Kaymakchalan, a phase of the Monastir Offensive.</td>
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<tr>
<td>September 14–17</td>
<td>Seventh Battle of the Isonzo</td>
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<tr>
<td>September 15–22</td>
<td>Battle of Flers-Courcelette; the British use armored tanks for the first time in history.</td>
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<tr>
<td>September 17–19</td>
<td>First Battle of Cobadin, a phase of the conquest of Romania.</td>
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<tr>
<td>September 20</td>
<td>The Brusilov Offensive ends with a substantial Russian success.</td>
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<tr>
<td>September 25–28</td>
<td>Battle of Morval (part of the final stages of the Battle of the Somme)</td>
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<tr>
<td>September 26–28</td>
<td>Battle of Thiepval Ridge (part of the final stages of the Battle of the Somme)</td>
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<tr>
<td>September 29 –</td>
<td>Flamanda Offensive, a phase of the conquest of Romania.</td>
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<tr>
<td>Date</td>
<td>Event Description</td>
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<tr>
<td>October 5</td>
<td>First Battle of the Cerna Bend, a phase of the Monastir Offensive.</td>
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<tr>
<td>October 1 – November 5</td>
<td>Battle of Le Transloy (last stage of the Battle of the Somme)</td>
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<tr>
<td>October 1 – November 11</td>
<td>Battle of Ancre Heights (last stage of the Battle of the Somme).</td>
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<tr>
<td>October 9–12</td>
<td>Eighth Battle of the Isonzo.</td>
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<tr>
<td>October 14 - January 6, 1917</td>
<td>Battle of Kibata.</td>
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<tr>
<td>October 19–25</td>
<td>Second Battle of Cobadin, a phase of the conquest of Romania.</td>
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<tr>
<td>October 24</td>
<td>The French recapture Fort Douaumont near Verdun.</td>
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<tr>
<td>November 1–4</td>
<td>Ninth Battle of the Isonzo.</td>
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<tr>
<td>November 11</td>
<td>Battle of Matamondo.</td>
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<tr>
<td>November 13–18</td>
<td>Battle of the Ancre (closing phase of the Battle of the Somme)</td>
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<tr>
<td>November 18</td>
<td>The Battle of the Somme ends with enormous casualties and an Anglo-French advantage.</td>
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<tr>
<td>November 21</td>
<td><em>HMHS Britannic</em> sinks after hitting a German mine. Francis Joseph I, Emperor of Austria and King of Hungary, dies and is succeeded by Charles I.</td>
<td></td>
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<tr>
<td>November 25</td>
<td>David Beatty replaces John Jellicoe as commander of the <em>Grand Fleet</em>. Jellicoe becomes First Lord of the Sea.</td>
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<tr>
<td>November 25 – December 3</td>
<td>Battle of Bucharest, a phase of the conquest of Romania.</td>
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<tr>
<td>November 28</td>
<td>Prunaru Charge, a phase of the Battle of Bucharest, Romanian cavalry desperately charge into enemy lines.</td>
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<tr>
<td>December 1</td>
<td>Battle of the Arges, a phase of the Battle of Bucharest.</td>
<td></td>
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<tr>
<td>December 1 – January 18, 1917</td>
<td>Allies capture Yanbu.</td>
<td></td>
</tr>
<tr>
<td>December 3–6</td>
<td>In a four-day crisis December 3–6, 1916, H. H. Asquith is unaware how fast he is losing support. David Lloyd George now has growing Unionist support, the backing of Labour and (thanks to Christopher Addison) a majority of Liberal MPs. Asquith falls.</td>
<td></td>
</tr>
<tr>
<td>December 7–31</td>
<td>The new Prime Minister Lloyd George answers the loud demands for a much more decisive government. He energetically sets up a new small war cabinet, a cabinet secretariat under Maurice Hankey, a secretariat of private advisors in the 'Garden Suburb' and moved towards prime ministerial control.</td>
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<tr>
<td>December 6</td>
<td>The Germans occupy Bucharest. The capital of Romania moved to Iași.</td>
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<tr>
<td>December 13</td>
<td>Robert Nivelle replaces Joseph Joffre as Commander-in-Chief of the French Army.</td>
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<tr>
<td>December 17</td>
<td>Kaoen Revolt: The Tuareg besiege the French garrison at Agadez.</td>
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<tr>
<td>December 18</td>
<td>Battle of Verdun ends with enormous casualties on both sides.</td>
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<tr>
<td>December 23</td>
<td>Battle of Magdhaba in the Sinai peninsula.</td>
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<tr>
<td>December 23–29</td>
<td>Christmas Battles.</td>
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<tr>
<td>December 27</td>
<td>Togoland is divided into British and French administrative zones.</td>
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<tr>
<td>December 30</td>
<td>Grigori Rasputin, Russia's éminence grise, is assassinated.</td>
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</tbody>
</table>

1917

<table>
<thead>
<tr>
<th>Dates</th>
<th>Events</th>
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<tbody>
<tr>
<td>January 3–4</td>
<td>Battle of Behobeho.</td>
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<tr>
<td>January 9</td>
<td>Battle of Rafa. The British drive the Ottomans out of Sinai.</td>
</tr>
<tr>
<td>January 11 –</td>
<td>British raid the Ancre.</td>
</tr>
<tr>
<td>March 13</td>
<td>The German Foreign Secretary Arthur Zimmermann sends a telegram to his ambassador in Mexico, instructing him to propose to the Mexican government an alliance against the United States.</td>
</tr>
<tr>
<td>February 1</td>
<td>Germany resumes unrestricted submarine warfare.</td>
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<tr>
<td>February 3</td>
<td>SS Housatonic an American steamer carrying wheat from Galveston, Texas to England is sunk by a U-boat.</td>
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<tr>
<td>February 13</td>
<td>Mata Hari is arrested in Paris on charges of spying for the Germans.</td>
</tr>
<tr>
<td>February 23</td>
<td>Second Battle of Kut. The British recapture the city.</td>
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<tr>
<td>February 23 –</td>
<td>The Germans withdraw to the Hindenburg Line.</td>
</tr>
<tr>
<td>April 5</td>
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<tr>
<td>March 1</td>
<td>Arz von Straussenberg replaces Conrad von Hőtzendorf as Austro-Hungarian Chief of Staff.</td>
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<tr>
<td>March 3</td>
<td>The French relieve Agadez.</td>
</tr>
<tr>
<td>March 8–11</td>
<td>The British capture Baghdad.</td>
</tr>
<tr>
<td>March 8</td>
<td>The celebrations of the International Women's Day in Petrograd spawn severe protests that will evolve into the February Revolution.</td>
</tr>
<tr>
<td>March 12</td>
<td>Russian troops refuse to fire on demonstrators after 50 are killed in Petrograd's Znamenskaya Square the day before. Numerous attacks against prisons, courts, police stations and Okhrana offices. Provisional Committee of the Duma formed. Petrograd Soviet formed.</td>
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<tr>
<td>Date</td>
<td>Event</td>
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<tr>
<td>March 13</td>
<td>Battle of Nambanje.</td>
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<tr>
<td>March 13 – April 23</td>
<td>Samarrah Offensive, British capture much of Mesopotamia.</td>
</tr>
<tr>
<td>March 14</td>
<td>China severs relations with Germany.</td>
</tr>
<tr>
<td>March 15</td>
<td>Nicholas II abdicates. A provisional government is formed.</td>
</tr>
<tr>
<td>March 16</td>
<td>Lenin arrives in Petrograd from his exile in Switzerland and publishes his April Thesis.</td>
</tr>
<tr>
<td>March 17</td>
<td>Aristide Briand resigns as Prime Minister of France; he is replaced by Alexandre Ribot.</td>
</tr>
<tr>
<td>March 26</td>
<td>First Battle of Gaza. The British attempt to capture the city fails.</td>
</tr>
<tr>
<td>April</td>
<td>Stalemate in Southern Palestine.</td>
</tr>
<tr>
<td>April 2 – 3</td>
<td>Australians attack Noreuil.</td>
</tr>
<tr>
<td>April 6</td>
<td>The United States declares war on Germany.</td>
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<tr>
<td>April 7</td>
<td>Cuba declares war on Germany.</td>
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<td></td>
<td>Panama declares war on Germany.</td>
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<tr>
<td></td>
<td>Scuttling of SMS Cormoran in Guam, the only hostile action between American and German forces in the Pacific.</td>
</tr>
<tr>
<td>April 9 – May 17</td>
<td>Second Battle of Arras. The British attack a heavily fortified German line without obtaining any strategic breakthrough.</td>
</tr>
<tr>
<td>April 9 – 12</td>
<td>The Canadians obtain a significant victory in the Battle of Vimy Ridge, part of the first phase of the Second Battle of Arras.</td>
</tr>
<tr>
<td>April 9 – 14</td>
<td>First Battle of the Scarpe, part of the first phase of the Second Battle of Arras.</td>
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<tr>
<td>April 10 – 11</td>
<td>First Battle of Bullecourt, part of the first phase of the Second Battle of Arras.</td>
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<tr>
<td>April 11</td>
<td>Brazil severs relations with Germany.</td>
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<tr>
<td>April 13</td>
<td>Bolivia severs relations with Germany.</td>
</tr>
<tr>
<td>April 15</td>
<td>Battle of Lagnicourt, part of the Second phase of the Second Battle of Arras.</td>
</tr>
<tr>
<td>April 16 – May 9</td>
<td>The Second Battle of the Aisne (also known as Nivelle Offensive) ends in disaster for both the French army and its commander Robert Nivelle.</td>
</tr>
<tr>
<td>April 17 – 20</td>
<td>Battle of the Hills (also known as Third battle of Champagne), a diversion to the Second Battle of the Aisne.</td>
</tr>
<tr>
<td>April 19</td>
<td>Second Battle of Gaza. The Ottoman lines resist a British attack.</td>
</tr>
<tr>
<td>April 22 – May 8</td>
<td>Second Battle of Doiran.</td>
</tr>
<tr>
<td>April 23</td>
<td>The Ottoman Empire severs relations with the United States.</td>
</tr>
<tr>
<td>April 23 – 24</td>
<td>Second Battle of Scarpe, part of the second phase of the Second Battle of Arras.</td>
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<tr>
<td>April 28 – 29</td>
<td>Battle of Arleux, part of the Second phase of the Second Battle of Arras.</td>
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<tr>
<td>April 29 – May 20</td>
<td>Series of mutinies in the French army.</td>
</tr>
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<td>Date</td>
<td>Event</td>
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<tr>
<td>May 3–4</td>
<td>Third battle of the Scarpe, part of the second phase of the Second Battle of Arras. Mass demonstrations in Petrograd and Moscow to protest Pavel Milyukov's note affirming Russia's commitment to the Entente war effort.</td>
</tr>
<tr>
<td>May 3–17</td>
<td>Second Battle of Bullecourt, part of the second phase of the Second Battle of Arras.</td>
</tr>
<tr>
<td>May 5</td>
<td>Australian Prime Minister Billy Hughes wins an enlarged majority in federal elections with the pro-conscription Nationalist Party.</td>
</tr>
<tr>
<td>May 5–15</td>
<td>Allied Spring offensive on the Salonika Front.</td>
</tr>
<tr>
<td>May 5–9</td>
<td>Second Battle of the Cerna Bend, a phase of the Allied Spring Offensive.</td>
</tr>
<tr>
<td>May 12 – June 6</td>
<td>Tenth Battle of the Isonzo.</td>
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<tr>
<td>May 15</td>
<td>Philippe Pétain replaces Robert Nivelle as Commander-in-Chief of the French Army.</td>
</tr>
<tr>
<td>May 23</td>
<td>Battle of Mount Hermada in the Karst. Salonika Trial ends: Dragutin Dimitrijevic, chief conspirator of the Sarajevo Assassination, is sentenced to death by Serbia on trumped up charges, as part of negotiations for a peace treaty with Austria-Hungary.</td>
</tr>
<tr>
<td>June–October</td>
<td>Operation Hush, Abortive British plan to capture coast of Belgium.</td>
</tr>
<tr>
<td>June 7–14</td>
<td>Second Battle of Messines, the British blow 19 deep mines and recapture Messines Ridge.</td>
</tr>
<tr>
<td>June 10–29</td>
<td>Battle of Mount Ortigara.</td>
</tr>
<tr>
<td>June 12</td>
<td>Constantine I of Greece abdicates.</td>
</tr>
<tr>
<td>June 13</td>
<td>First successful heavy bomber raid on London done by the Gotha G.IV.</td>
</tr>
<tr>
<td>June 25</td>
<td>First American troops land in France.</td>
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<tr>
<td>June 27</td>
<td>Batterie Pommern aka. 'Lange Max', world's largest gun fires for the first time from Koekelare to Dunkirk (±50 km).</td>
</tr>
<tr>
<td>June 30</td>
<td>Greece declares war on the Central powers.</td>
</tr>
<tr>
<td>July 1–2</td>
<td>Battle of Zborov, a phase of the Kerensky Offensive.</td>
</tr>
<tr>
<td>July 1–12</td>
<td>Brief monarchist coup and restoration in China, allegedly promoted by Germany to distance China from the Entente.</td>
</tr>
<tr>
<td>July 1–19</td>
<td>The Kerensky Offensive fails. It is the last Russian initiative in the war.</td>
</tr>
<tr>
<td>July 6</td>
<td>Arab rebels led by Lawrence of Arabia seize the Jordanian port of Aqaba.</td>
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<tr>
<td>July 11</td>
<td>The Open Letter to Albert I is published by Flemish Movement sympathisers within the Belgian Army on the Yser Front, complaining about official discrimination against Dutch language</td>
</tr>
<tr>
<td>July 16–17</td>
<td>Petrograd July Days.</td>
</tr>
<tr>
<td>July 19</td>
<td>The Reichstag passes a Peace Resolution.</td>
</tr>
<tr>
<td>July 20</td>
<td>Corfu Declaration about the future Kingdom of Yugoslavia.</td>
</tr>
<tr>
<td>July 21</td>
<td>Alexander Kerensky replaces Georgy Lvov as Minister-President of the Russian Provisional Government.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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<tr>
<td>--------------</td>
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</tr>
<tr>
<td>July 22</td>
<td>Siam declares war on Germany and Austria-Hungary.</td>
</tr>
<tr>
<td>July 22 –</td>
<td>Battle of Mărăști</td>
</tr>
<tr>
<td>August 1</td>
<td></td>
</tr>
<tr>
<td>July 29</td>
<td>Battle of Kiawe Bridge.</td>
</tr>
<tr>
<td>July 31</td>
<td>The Third Battle of Ypres (also known as Battle of Passchendaele) begins.</td>
</tr>
<tr>
<td>July 31 –</td>
<td>Battle of Pilckem Ridge (Opening phase of the Third Battle of Ypres).</td>
</tr>
<tr>
<td>August 2</td>
<td></td>
</tr>
<tr>
<td>August 2</td>
<td>The German raider SMS <em>Seeadler</em> is wrecked at Mopelia in French Polynesia.</td>
</tr>
<tr>
<td>August 2 –10</td>
<td>Battle of Rumbo.</td>
</tr>
<tr>
<td>August 4</td>
<td>Liberia declares war on Germany.</td>
</tr>
<tr>
<td>August 6–20</td>
<td>Battle of Mărășești.</td>
</tr>
<tr>
<td>August 8–22</td>
<td>Third Battle of Oituz.</td>
</tr>
<tr>
<td>August 14</td>
<td>China declares war on Germany and Austria-Hungary.</td>
</tr>
<tr>
<td>August 15–25</td>
<td>Battle of Hill 70 (Continuation of British operations near Lens).</td>
</tr>
<tr>
<td>August 16–18</td>
<td>Second Battle of Langemarck (Initial phase of the Third Battle of Ypres).</td>
</tr>
<tr>
<td>August 17</td>
<td>China terminates the German and Austro-Hungarian concessions in Tianjin and occupies them.</td>
</tr>
<tr>
<td>August 18–28</td>
<td>Eleventh Battle of the Isonzo.</td>
</tr>
<tr>
<td>August 20–26</td>
<td>Second Offensive Battle of Verdun.</td>
</tr>
<tr>
<td>September –</td>
<td>Operation Albion. German capture of Oesel, Dago and Moon Islands.</td>
</tr>
<tr>
<td>October</td>
<td></td>
</tr>
<tr>
<td>September 1–</td>
<td>Battle of Jugla.</td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>September 5</td>
<td>The SMS <em>Seeadler</em>'s crew sail to Fiji in a lifeboat and capture the French schooner <em>Lutece</em>, allowing their escape. They rename it <em>Fortuna</em>.</td>
</tr>
<tr>
<td>September 5–12</td>
<td>The Third Zimmerwald Conference of the anti-war socialist Zimmerwald Movement, is held in Stockholm.</td>
</tr>
<tr>
<td>September 8–12</td>
<td>Russia: General Kornilov's coup attempt fails.</td>
</tr>
<tr>
<td>September 12</td>
<td>Alexandre Ribot resigns as Prime Minister of France; he is replaced by Paul Painlevé.</td>
</tr>
<tr>
<td>September 14</td>
<td>Russia declared a republic.</td>
</tr>
<tr>
<td>September 20–26</td>
<td>Battle of the Menin Road Ridge (Second phase of the Third Battle of Ypres).</td>
</tr>
<tr>
<td>September 21</td>
<td>Costa Rica severs relations with Germany.</td>
</tr>
<tr>
<td>September 26–27</td>
<td>Battle of Polygon Wood (Second phase of the Third Battle of Ypres).</td>
</tr>
<tr>
<td>September</td>
<td>Battle of Ramadi, Mesopotamia.</td>
</tr>
<tr>
<td>Date</td>
<td>Event Description</td>
</tr>
<tr>
<td>------------</td>
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</tr>
<tr>
<td>28–29 Oct</td>
<td>Battle of Broodseinde (Second phase of the Third Battle of Ypres).</td>
</tr>
<tr>
<td>5 Oct</td>
<td>The <em>Fortuna</em> wrecks at Easter Island and its crew is interned by the Chileans.</td>
</tr>
<tr>
<td>6 Oct</td>
<td>Peru severs relations with Germany.</td>
</tr>
<tr>
<td>7 Oct</td>
<td>Uruguay severs relations with Germany.</td>
</tr>
<tr>
<td>9 Oct</td>
<td>Battle of Poelcappelle (Last phase of the Third Battle of Ypres).</td>
</tr>
<tr>
<td>12 Oct</td>
<td>First Battle of Passchendaele (Last phase of the Third Battle of Ypres).</td>
</tr>
<tr>
<td>15 Oct</td>
<td>Mata Hari executed.</td>
</tr>
<tr>
<td>15–18 Oct</td>
<td>Battle of Mahiwa.</td>
</tr>
<tr>
<td>23 Oct</td>
<td>Battle of Wadi Musa.</td>
</tr>
<tr>
<td>23–10 Nov</td>
<td>Battle of La Malmaison, much-postponed French attack on the Chemin des Dames.</td>
</tr>
<tr>
<td>24–4 Nov</td>
<td>Battle of Caporetto. The Austro-Hungarians and Germans break through the Italian lines. The Italian army is defeated and falls back on the Piave River.</td>
</tr>
<tr>
<td>26 Oct</td>
<td>Brazil declares war on Germany.</td>
</tr>
<tr>
<td>26–10 Nov</td>
<td>Second Battle of Passchendaele (Last phase of the Third Battle of Ypres).</td>
</tr>
<tr>
<td>27 Oct</td>
<td>Battle of Buqqar Ridge.</td>
</tr>
<tr>
<td>30 Oct</td>
<td>Italy: Vittorio Emanuele Orlando succeeds Paolo Boselli as Prime Minister.</td>
</tr>
<tr>
<td>31–7 Nov</td>
<td>Third Battle of Gaza. The British break through the Ottoman lines.</td>
</tr>
<tr>
<td>31 Oct</td>
<td>Battle of Beersheba (opening phase of the Third Battle of Gaza).</td>
</tr>
<tr>
<td>1–6 Nov</td>
<td>Battle of Tel el Khuweilfe.</td>
</tr>
<tr>
<td>2 Nov</td>
<td>Balfour Declaration: the British government supports plans for a Jewish &quot;national home&quot; in Palestine.</td>
</tr>
<tr>
<td>5 Nov</td>
<td>The Allies agree to establish a Supreme War Council at Versailles.</td>
</tr>
<tr>
<td>7 Nov</td>
<td>October Revolution: Kerensky flees Petrograd just before the Petrograd Soviet seizes the Winter Palace. Charge at Sheria.</td>
</tr>
<tr>
<td>8 Nov</td>
<td>Armando Diaz replaces Luigi Cadorna as Commander-in-Chief of the Italian Army.</td>
</tr>
<tr>
<td>9–28 Dec</td>
<td>First Battle of the Piave: the Austro-Hungarians and Germans try unsuccessfully to cross the river.</td>
</tr>
<tr>
<td>10 Nov</td>
<td>The Third Battle of Ypres (also known as Battle of Passchendaele) ends.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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<tr>
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</tr>
<tr>
<td>November 11</td>
<td>First Battle of Monte Grappa, Austro-Hungarian offensive halted.</td>
</tr>
<tr>
<td>– December 23</td>
<td></td>
</tr>
<tr>
<td>November 13</td>
<td>France: Paul Painlevé is replaced by Georges Clemenceau as Prime Minister.</td>
</tr>
<tr>
<td></td>
<td>Battle of Mughar Ridge.</td>
</tr>
<tr>
<td>November 14</td>
<td>Battle of Ayun Kara.</td>
</tr>
<tr>
<td>November 17</td>
<td>Second Battle of Heligoland Bight, North Sea.</td>
</tr>
<tr>
<td>November 17</td>
<td>Battle of Jerusalem. The British enter the city (December 11).</td>
</tr>
<tr>
<td>– December 30</td>
<td></td>
</tr>
<tr>
<td>November 18–24</td>
<td>Battle of Nebi Samwil, a phase of the Battle of Jerusalem.</td>
</tr>
<tr>
<td>November 19</td>
<td>Battle of Caporetto ends. Central Powers take a quarter of a million prisoners.</td>
</tr>
<tr>
<td>November 20</td>
<td>First Battle of Cambrai. A British attack and the biggest German attack against the British since 1915 succeed and the battle is a stalemate.</td>
</tr>
<tr>
<td>– December 3</td>
<td></td>
</tr>
<tr>
<td>November 25</td>
<td>Battle of Ngomano, the Germans invade Portuguese East Africa to gain supplies.</td>
</tr>
<tr>
<td>December 1</td>
<td>Battle of El Burj, a phase of the Battle of Jerusalem.</td>
</tr>
<tr>
<td>December 6</td>
<td>Halifax Explosion: An accidental collision between the Norwegian supply ship SS Imo and the French cargo ship SS Mont-Blanc, laden with high explosives for the Western Front, leaves 2,000 dead and 9,000 injured in Richmond, Nova Scotia. It is the largest man-made explosion before the invention of atomic weapons.</td>
</tr>
<tr>
<td>December 7</td>
<td>Finland declares independence from Russia.</td>
</tr>
<tr>
<td>December 8</td>
<td>The United States declares war on Austria-Hungary.</td>
</tr>
<tr>
<td>December 9</td>
<td>Ecuador severs relations with Germany.</td>
</tr>
<tr>
<td>December 10</td>
<td>Romania signs an armistice with the Central Powers.</td>
</tr>
<tr>
<td>December 11</td>
<td>Panama declares war on Austria-Hungary.</td>
</tr>
<tr>
<td>December 11</td>
<td>General Allenby leads British and Indian troops into Jerusalem, ending 400 years of Ottoman rule.</td>
</tr>
<tr>
<td>December 15</td>
<td>Armistice between Russia and the Central Powers, to take effect on December 17.</td>
</tr>
<tr>
<td>December 16</td>
<td>Armistice of Erzincan between the Ottomans and the Russian Special Transcaucasian Committee.</td>
</tr>
<tr>
<td>December 17</td>
<td>Canadian Prime Minister Robert Borden wins an enlarged majority in federal elections with the pro-conscription Unionist Party.</td>
</tr>
<tr>
<td>December 20–21</td>
<td>Battle of Jaffa, a phase of the Battle of Jerusalem.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>January 8</td>
<td>Woodrow Wilson outlines his Fourteen Points.</td>
</tr>
<tr>
<td>February to September</td>
<td>Allied forces occupy the Jordan Rift Valley.</td>
</tr>
<tr>
<td>February 9</td>
<td>The Central Powers sign an exclusive protectorate treaty with the Ukrainian People's Republic as part of the negotiations in Brest-Litovsk.</td>
</tr>
<tr>
<td>February 15–16</td>
<td>Battle of Rarancza.</td>
</tr>
<tr>
<td>February 18 – March 3</td>
<td>Operation Faustschlag, last offensive on Eastern Front.</td>
</tr>
<tr>
<td>February 19</td>
<td>British begin their assault on Jericho.</td>
</tr>
<tr>
<td>February 21</td>
<td>The British capture Jericho. Germans capture Minsk.</td>
</tr>
<tr>
<td>February 24</td>
<td>Germans capture Zhytomyr.</td>
</tr>
<tr>
<td>February 25</td>
<td>German troops capture Tallinn.</td>
</tr>
<tr>
<td>February 28</td>
<td>Germans capture Pskov and Narva.</td>
</tr>
<tr>
<td>March 2</td>
<td>Germans capture Kiev.</td>
</tr>
<tr>
<td>March 3</td>
<td>At Brest-Litovsk, Leon Trotsky signs the peace treaty with Germany.</td>
</tr>
<tr>
<td>March 4</td>
<td>First known case of what will later be called Spanish flu: Private Albert Gitchell at Camp Funston, Fort Riley, Kansas.</td>
</tr>
<tr>
<td>March 7</td>
<td>German artillery bombard the Americans at Rouge Bouquet.</td>
</tr>
<tr>
<td>March 8–12</td>
<td>Battle of Tell 'Asur.</td>
</tr>
<tr>
<td>March 8–13</td>
<td>Battle of Bakhmach.</td>
</tr>
<tr>
<td>March 11</td>
<td>Over 100 sick from Spanish flu in Fort Riley; first known case outside in Queens, New York.</td>
</tr>
<tr>
<td>March 21–23</td>
<td>The Battle of St. Quentin, first phase of Operation Michael and of the Spring Offensive.</td>
</tr>
<tr>
<td>March 21–April 2</td>
<td>First Transjordan attack on Amman.</td>
</tr>
<tr>
<td>March 23–August 7</td>
<td>Artillery bombardment of Paris.</td>
</tr>
<tr>
<td>March 24–25</td>
<td>First Battle of Bapaume, a phase of Operation Michael.</td>
</tr>
<tr>
<td>March 25</td>
<td>First Battle of Noyon, a phase of Operation Michael.</td>
</tr>
<tr>
<td>March 26</td>
<td>French Marshal Ferdinand Foch is appointed Supreme Commander of all Allied forces.</td>
</tr>
<tr>
<td>March 25</td>
<td>Penza Agreement: The Czechoslovak Legion is given free passage to Vladivostok to join the Entente in return for surrendering most weapons to the Bolsheviks.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>March 27–31</td>
<td>First Battle of Amman, a phase of The First Transjordan Attack.</td>
</tr>
<tr>
<td>March 28</td>
<td>Third Battle of Arras (also known as First Battle of Arras (1918)), a phase of Operation Michael.</td>
</tr>
<tr>
<td>March 30– April 5</td>
<td>First Battle of Villers-Bretonneux, a phase of Operation Michael.</td>
</tr>
<tr>
<td>March 30</td>
<td>Battle of Moreuil Wood.</td>
</tr>
<tr>
<td>April 1</td>
<td>Royal Air Force founded by combining the Royal Flying Corps and the Royal Naval Air Service.</td>
</tr>
<tr>
<td>April 4–5</td>
<td>Battle of the Avre, final phase of Operation Michael.</td>
</tr>
<tr>
<td>April 7–29</td>
<td>Second phase of the Spring Offensive, Operation Georgette (also known as Battle of the Lys). The results are disappointing for the Germans.</td>
</tr>
<tr>
<td>April 7–9</td>
<td>Battle of Estaires, first phase of Operation Georgette.</td>
</tr>
<tr>
<td>April 10–11</td>
<td>Third Battle of Messines, a phase of Operation Georgette.</td>
</tr>
<tr>
<td>April 12–13</td>
<td>Battle of Hazebrouck, a phase of Operation Georgette.</td>
</tr>
<tr>
<td>April 13–15</td>
<td>Battle of Bailleul, a phase of Operation Georgette.</td>
</tr>
<tr>
<td>April 14</td>
<td>Ottokar Czernin resigns as Austria-Hungary's Foreign Minister over the Sixtus Affair.</td>
</tr>
<tr>
<td>April 17–19</td>
<td>First Battle of Kemmelberg, a phase of Operation Georgette.</td>
</tr>
<tr>
<td>April 18</td>
<td>Battle of Bethune, a phase of Operation Georgette.</td>
</tr>
<tr>
<td>April 21</td>
<td>The Red Baron is shot down over Vaux-sur-Somme.</td>
</tr>
<tr>
<td>April 23</td>
<td>Guatemala declares war on Germany.</td>
</tr>
<tr>
<td>April 24–27</td>
<td>Second Battle of Villers-Bretonneux, a phase of Operation Georgette.</td>
</tr>
<tr>
<td>April 25–26</td>
<td>Second Battle of Kemmelberg, a phase of Operation Georgette.</td>
</tr>
<tr>
<td>April 28</td>
<td>Gavrilo Princip dies in Terezín prison, from tuberculosis.</td>
</tr>
<tr>
<td>April 29</td>
<td>Battle of Scherpenberg, final phase of Operation Georgette.</td>
</tr>
<tr>
<td>April 30– May 4</td>
<td>Second Transjordan attack on Shunet Nimrin and Es Salt.</td>
</tr>
<tr>
<td>May 7</td>
<td>Treaty of Bucharest between Romania and the Central Powers. It will never be ratified.</td>
</tr>
<tr>
<td>May 8</td>
<td>Nicaragua declares war on Germany and Austria-Hungary.</td>
</tr>
<tr>
<td>May 10–11</td>
<td>Battle of Kaniow.</td>
</tr>
<tr>
<td>May 14</td>
<td>Clash at Chelyabinsk station between Hungarian POWs heading west to be repatriated and Czechoslovaks going east. Trotsky orders the arrest of the Czechoslovak Legion, but they revolt and seize several towns along the Trans-Siberian Railway.</td>
</tr>
<tr>
<td>May 21</td>
<td>Ottomans invade Armenia.</td>
</tr>
<tr>
<td>May 21–29</td>
<td>Battle of Sardarabad, a phase of the invasion of Armenia.</td>
</tr>
<tr>
<td></td>
<td>Battle of Abaran, a phase of the invasion of Armenia.</td>
</tr>
<tr>
<td>May 23</td>
<td>Costa Rica declares war on Germany.</td>
</tr>
<tr>
<td>May 24–28</td>
<td>Battle of Karakilisa, a phase of the invasion of Armenia.</td>
</tr>
<tr>
<td>May 27–June</td>
<td>Third Battle of the Aisne (also known as Operation Blücher-Yorck, third phase of the Spring</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>May 28</td>
<td>Battle of Cantigny</td>
</tr>
<tr>
<td>May 29–31</td>
<td>Battle of Skra-di-Legen</td>
</tr>
<tr>
<td>June 1–26</td>
<td>Battle of Belleau Wood, part of the German Spring Offensive.</td>
</tr>
<tr>
<td>June 8</td>
<td>Action of Arsuf.</td>
</tr>
<tr>
<td></td>
<td>Ottomans re-enter Tabriz.</td>
</tr>
<tr>
<td>June 8</td>
<td>The Czechoslovak Legion forms the Committee of Members of the Constituent Assembly in Samara. Stanislav Čeček calls to join forces with anti-Bolshevik Russians to overthrow the Communist government and reignite the Eastern Front.</td>
</tr>
<tr>
<td>June 8–October</td>
<td>Germany interferes in the Caucasus.</td>
</tr>
<tr>
<td>June 9–12</td>
<td>Fourth phase of the Spring Offensive, Operation Gneisenau (also known as Battle of Matz). Despite substantial territorial gains, the Germans do not achieve their strategic goals</td>
</tr>
<tr>
<td>June 13</td>
<td>Provisional Siberian Government formed in Omsk.</td>
</tr>
<tr>
<td>June 15–23</td>
<td>Second Battle of the Piave: the Austro-Hungarian offensive is repelled.</td>
</tr>
<tr>
<td>June 15–31</td>
<td>Ottomans occupy Dilman, Khoy and Urmia.</td>
</tr>
<tr>
<td>June 23</td>
<td>British and French troops land at Murmansk in Northern Russia. It's the beginning of Allied Intervention in the Russian Civil War on the White Army's side.</td>
</tr>
<tr>
<td>July 4</td>
<td>Battle of Hamel.</td>
</tr>
<tr>
<td>July 12</td>
<td>Haiti declares war on Germany.</td>
</tr>
<tr>
<td>July 14</td>
<td>Battle of Abu Tellul.</td>
</tr>
<tr>
<td>July 15–August 6</td>
<td>Second Battle of the Marne and last German offensive on the Western Front, which fails when the Germans are counterattacked by the French.</td>
</tr>
<tr>
<td>July 15–17</td>
<td>Champagne-Marne Offensive (consisting of the Fourth Battle of Champagne and the Battle of the Mountain of Reims), a phase of the Second Battle of the Marne. last phase of the Spring Offensive and last German offensive of World War I.</td>
</tr>
<tr>
<td>July 17</td>
<td>Nicholas II and his family are executed by the Bolsheviks, out of fear that they might be released by Czechoslovak and White troops.</td>
</tr>
<tr>
<td>July 18</td>
<td>Battle of Chateau-Thierry, a phase of the Second Battle of the Marne.</td>
</tr>
<tr>
<td>July 18–22</td>
<td>Battle of Soissons, a phase of the Second Battle of the Marne.</td>
</tr>
<tr>
<td>July 19</td>
<td>Battle of Tardenois, a phase of the Second Battle of the Marne.</td>
</tr>
<tr>
<td></td>
<td>Honduras declares war on Germany.</td>
</tr>
<tr>
<td>August</td>
<td>Spanish flu virus mutates: Simultaneous deadlier outbreaks in Brest, Freetown and Boston.</td>
</tr>
<tr>
<td>August 5</td>
<td>The Czechoslovak People's Army of Komuch takes Kazan from the Bolsheviks and captures the Imperial Russian gold reserve.</td>
</tr>
<tr>
<td>August 8–</td>
<td>Hundred Days Offensive, last offensive on Western Front.</td>
</tr>
<tr>
<td>Date</td>
<td>Event Description</td>
</tr>
<tr>
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</tr>
<tr>
<td>November 11</td>
<td>Battle of Amiens, first phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>August 8–12</td>
<td>Battle of Montdidier.</td>
</tr>
<tr>
<td>August 9–12</td>
<td>Battle of San Matteo.</td>
</tr>
<tr>
<td>August 13– September 3</td>
<td>Second Battle of Noyon, a phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>August 21– September 3</td>
<td>Second Battle of the Somme(also known as Third battle of the Somme), a phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>August 21–22</td>
<td>Third Battle of Albert, opening phase of the Second Battle of the Somme.</td>
</tr>
<tr>
<td>August 21– September 3</td>
<td>Second Battle of Bapaume, a phase of the Second Battle of the Somme.</td>
</tr>
<tr>
<td>August 26– September 3</td>
<td>Fourth Battle of Arras (also known as Second Battle of Arras (1918)), a phase of the Second Battle of the Somme.</td>
</tr>
<tr>
<td>August 26–30</td>
<td>Fourth Battle of the Scarpe (also known as Battle of the Scarpe (1918)), a phase of the Fourth Battle of Arras.</td>
</tr>
<tr>
<td>August 26– September 14</td>
<td>Battle of Baku, last Turkish offensive of the war.</td>
</tr>
<tr>
<td>August 30–31</td>
<td>Battle of Lioma.</td>
</tr>
<tr>
<td>August 31– September 3</td>
<td>Battle of Mont Saint-Quentin, a phase of the Second Battle of the Somme.</td>
</tr>
<tr>
<td>September 1–2</td>
<td>Battle of Peronne, a phase of the Battle of Mont Saint-Quentin.</td>
</tr>
<tr>
<td>September 2–3</td>
<td>Battle of Drocourt-Queant Line, final phase of the Second Battle of the Somme.</td>
</tr>
<tr>
<td>September 8–23</td>
<td>Ufa Conference: Formation of the Provisional All-Russian Government with the support of the Czechoslovak Legion.</td>
</tr>
<tr>
<td>September 10</td>
<td>Battle of Savy-Dallon, a phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>September 12</td>
<td>Battle of Havrincourt, a phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>September 12–19</td>
<td>Battle of Saint-Mihiel, a phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>September 14</td>
<td>Battle of Vauxaillon, a phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>September 14–29</td>
<td>Vardar Offensive, final offensive on the Balkan Front.</td>
</tr>
<tr>
<td>September 15</td>
<td>The Allies (French and Serbs) break through the Bulgarian lines at Dobro Polje, a phase of the Vardar Offensive.</td>
</tr>
<tr>
<td>September 18</td>
<td>Battle of Epehy, a phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>September 18–19</td>
<td>Third Battle of Doiran, a phase of the Vardar Offensive, The Bulgarians halt the British and Greek advance.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
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</tr>
<tr>
<td>September 18 – October 17</td>
<td>Battle of the Hindenburg Line, a phase of the Hundred Days Offensive. The Allies break through the German lines.</td>
</tr>
<tr>
<td></td>
<td>Battle of Nablus, a phase of the Battle of Megiddo.</td>
</tr>
<tr>
<td></td>
<td>Third Transjordan attack, a phase of the Battle of Nablus.</td>
</tr>
<tr>
<td></td>
<td>Battle of Sharon, a phase of the Battle of Megiddo.</td>
</tr>
<tr>
<td>September 22</td>
<td>The British capture Jisr ed Damieh in the Battle of Sharon.</td>
</tr>
<tr>
<td>September 25</td>
<td>The British capture Tiberias during the Battle of Sharon.</td>
</tr>
<tr>
<td>September 19</td>
<td>Battle of Tulkarm, a phase of the Battle of Sharon.</td>
</tr>
<tr>
<td></td>
<td>Battle of Arara, a phase of the Battle of Sharon.</td>
</tr>
<tr>
<td>September 19 – 20</td>
<td>Battle of Tabsor, a phase of the Battle of Sharon.</td>
</tr>
<tr>
<td>September 20</td>
<td>Capture of Jenin, a phase of the Battle of Sharon.</td>
</tr>
<tr>
<td></td>
<td>British capture both Afulah and Beisan during the Battle of Sharon.</td>
</tr>
<tr>
<td>September 20 – 21</td>
<td>Battle of Nazareth, a phase of the Battle of Sharon.</td>
</tr>
<tr>
<td>September 23</td>
<td>Battle of Haifa, a phase of the Battle of Sharon.</td>
</tr>
<tr>
<td>September 25</td>
<td>Battle of Samakh, a phase of the Battle of Sharon.</td>
</tr>
<tr>
<td></td>
<td>Second Battle of Amman, a phase of the Third Transjordan Attack.</td>
</tr>
<tr>
<td>September 26 – November 11</td>
<td>Meuse-Argonne Offensive, the final phase of the Hundred Days Offensive and of World War I.</td>
</tr>
<tr>
<td>September 26 – October 1</td>
<td>The British enter Damascus.</td>
</tr>
<tr>
<td>September 26</td>
<td>Battle of Somme-Py (Initial phase of the Meuse-Argonne Offensive).</td>
</tr>
<tr>
<td></td>
<td>Charge at Irbid, a phase of the Capture of Damascus.</td>
</tr>
<tr>
<td>September 26 – 27</td>
<td>British capture Deraa during the Capture of Damascus.</td>
</tr>
<tr>
<td>September 27</td>
<td>Battle of Jisr Benat Yakub, a phase of the Capture of Damascus.</td>
</tr>
<tr>
<td>September 27 – October 1</td>
<td>Battle of the Canal du Nord, a phase of the Battle of the Hindenburg Line.</td>
</tr>
<tr>
<td>September 28 – October 2</td>
<td>Fifth Battle of Ypres (also known as Advance on Flanders), a phase of the Battle of the Hindenburg Line.</td>
</tr>
<tr>
<td>September 29 – October 10</td>
<td>Battle of St. Quentin Canal, a phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>September 30</td>
<td>Bulgaria signs an armistice with the Allies.</td>
</tr>
<tr>
<td></td>
<td>Battle of Saint-Thierry (Initial phase of the Meuse-Argonne Offensive).</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>October 3</td>
<td>Tsar Ferdinand I of Bulgaria abdicates and Boris III accedes to the throne.</td>
</tr>
<tr>
<td>October 3–27</td>
<td>Pursuit to Haritan.</td>
</tr>
<tr>
<td>October 4</td>
<td>Battle of Blanc Mont Ridge.</td>
</tr>
<tr>
<td>October 8–10</td>
<td>Second Battle of Cambrai (also known as Battle of Cambrai (1918)), a phase of the Battle of the Hindenburg Line.</td>
</tr>
<tr>
<td>October 14–17</td>
<td>Battle of Montfaucon (intermediate phase of the Meuse-Argonne Offensive).</td>
</tr>
<tr>
<td>October 14–19</td>
<td>Battle of Courtrai, closing phase of the Hundred Days offensive.</td>
</tr>
<tr>
<td>October 15</td>
<td>Battle of Mont-D'Origny, a phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>October 17–26</td>
<td>Battle of the Selle, closing phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>October 20</td>
<td>Germany suspends submarine warfare.</td>
</tr>
<tr>
<td>October 23–30</td>
<td>Battle of Sharqat.</td>
</tr>
<tr>
<td>October 24 – November 4</td>
<td>Battle of Vittorio Veneto. The Austro-Hungarian army is routed. The Italians enter Trent and land at Triest.</td>
</tr>
<tr>
<td>October 24–28</td>
<td>Second Battle of Monte Grappa, beginning phase of Vittorio Veneto.</td>
</tr>
<tr>
<td>October 25</td>
<td>Battle of Aleppo.</td>
</tr>
<tr>
<td>October 29</td>
<td>Wilhelm Groener replaces Erich Ludendorff as Hindenburg's deputy.</td>
</tr>
<tr>
<td>October 30</td>
<td>Germany's Hochseeflotte mutinies.</td>
</tr>
<tr>
<td>October 30</td>
<td>State of Slovenes, Croats and Serbs proclaimed.</td>
</tr>
<tr>
<td>November</td>
<td>The Ottoman Empire signs the Armistice of Mudros.</td>
</tr>
<tr>
<td>November 1</td>
<td>First Spanish flu cases in Spain, where reports on the disease are published freely due to the lack of wartime censorship.</td>
</tr>
<tr>
<td>November 1–2</td>
<td>Battle of Valenciennes, closing phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>November 3</td>
<td>Austria-Hungary signs the armistice with Italy, effective November 4.</td>
</tr>
<tr>
<td>November 4</td>
<td>Battle of the Sambre, closing phase of the Hundred Days Offensive.</td>
</tr>
<tr>
<td>November 6–11</td>
<td>Advance to the Meuse.</td>
</tr>
<tr>
<td>November 9</td>
<td>Germany: Kaiser William II abdicates; republic proclaimed.</td>
</tr>
</tbody>
</table>
### November 10
- Austria-Hungary: Kaiser Charles I abdicates.
- Romania renews the war against the Central Powers.

### November 11
- At 6 am, Germany signs the Armistice of Compiègne. **End of fighting at 11 a.m.**
- Poland proclaimed.

### November 12
- Austria proclaimed a republic.

### November 14
- Czechoslovakia proclaimed a republic.
- German U-boats interned.
- 3 days after the armistice, fighting ends in the East African theater when General von Lettow-Vorbeck agrees a cease-fire on hearing of Germany's surrender.

### November 18
- Alexander Kolchak seizes control of the Provisional All-Russian Government in a coup.

### November 21
- Germany's *Hochseeflotte* surrendered to the United Kingdom.

### November 22
- The Germans evacuate Luxembourg.

### November 25
- 11 days after agreeing a cease-fire, General von Lettow-Vorbeck formally surrenders his undefeated army at Abercorn in present-day Zambia.

### November 27
- The Germans evacuate Belgium.

### December 1
- Kingdom of Serbs, Croats and Slovenes proclaimed.

### 1919

<table>
<thead>
<tr>
<th>Dates</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 5</td>
<td>Hermann Detzner surrenders at the Finschhafen District of New Guinea.</td>
</tr>
<tr>
<td>January 10</td>
<td>Fakhri Pasha surrenders at Medina.</td>
</tr>
<tr>
<td>January 25</td>
<td>Proposal to create the League of Nations accepted.</td>
</tr>
<tr>
<td>January 27</td>
<td>The Czechoslovak Legion assumes complete control of the Trans-Siberian Railway.</td>
</tr>
<tr>
<td>June 21</td>
<td>German High Seas Fleet (53 ships) scuttled in Scapa Flow with nine deaths, the last casualties of the war.</td>
</tr>
<tr>
<td>June 28</td>
<td>Treaty of Versailles signed.</td>
</tr>
<tr>
<td>July 8</td>
<td>Germany ratifies the Treaty of Versailles.</td>
</tr>
<tr>
<td>July 21</td>
<td>The United Kingdom ratifies the Treaty of Versailles.</td>
</tr>
<tr>
<td>November 10–11</td>
<td>A Banquet in Honour of The President of the French Republic is hosted by King George V and held at Buckingham Palace during the evening hours of November 10. The very first Armistice Day is held on the Grounds of Buckingham Palace on the Morning of November 11. This will set the trend for the later Remembrance Day.</td>
</tr>
<tr>
<td>November 14</td>
<td>The Bolsheviks take Omsk. Kolchak's retreat east is impeded by the Czechoslovaks denying him use of the Trans-Siberian.</td>
</tr>
</tbody>
</table>
### 1920

<table>
<thead>
<tr>
<th>Dates</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>January 4</td>
<td>A coup in Irkutsk deposes Kolchak.</td>
</tr>
<tr>
<td>January 10</td>
<td>First meeting of the League of Nations held in London. <strong>Official end of World War I.</strong></td>
</tr>
<tr>
<td></td>
<td>Free City of Danzig established.</td>
</tr>
<tr>
<td>January 20</td>
<td>Irkutsk surrenders to the Bolsheviks.</td>
</tr>
<tr>
<td>January 21</td>
<td>The Paris Peace Conference ends.</td>
</tr>
<tr>
<td>February 7</td>
<td>Armistice between the Bolsheviks and the Czechoslovak Legion. The Czechoslovaks surrender the Russian gold reserves and Kolchak in return for free passage to Vladivostok. Kolchak and his Prime Minister, Viktor Pepelyayev are executed.</td>
</tr>
<tr>
<td>February 10</td>
<td>A plebiscite returns Northern Schleswig to Denmark.</td>
</tr>
<tr>
<td>April 19–26</td>
<td>Conference of Sanremo, Italy, about League of Nations mandates in former Ottoman territories of the Middle East.</td>
</tr>
<tr>
<td>June 4</td>
<td>Treaty of Trianon between the Allies and Hungary.</td>
</tr>
<tr>
<td>August 10</td>
<td>Treaty of Sèvres between the Allies and the Ottoman Empire. The treaty is not recognized by the Turkish national movement, which considers the Istanbul government illegitimate.</td>
</tr>
<tr>
<td>September 8</td>
<td>Gabriele D'Annunzio proclaims in Fiume the Italian Regency of Carnaro.</td>
</tr>
<tr>
<td>November 1</td>
<td>League of Nations headquarters moved to Geneva, Switzerland.</td>
</tr>
<tr>
<td>November 12</td>
<td>Treaty of Rapallo between Italy and Yugoslavia. Zadar is annexed by Italy and the Free State of Fiume is established.</td>
</tr>
<tr>
<td>November 15</td>
<td>The League of Nations holds its first general assembly.</td>
</tr>
</tbody>
</table>

### Post-1920

<table>
<thead>
<tr>
<th>Dates</th>
<th>Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>October 13</td>
<td>Treaty of Kars between Bolshevik Russia and Turkey.</td>
</tr>
<tr>
<td>1921</td>
<td></td>
</tr>
<tr>
<td>1922</td>
<td></td>
</tr>
<tr>
<td>February 6</td>
<td>Washington Naval Treaty, limiting naval tonnage, signed by France, Italy, Japan, the United Kingdom and the United States.</td>
</tr>
<tr>
<td>April 10 – May 19</td>
<td>Genoa Conference. Representatives of 34 countries discuss economics in the wake of the Great War.</td>
</tr>
<tr>
<td>April 16</td>
<td>Treaty of Rapallo between Germany and Bolshevik Russia to normalize diplomatic relations.</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------------------------------------------</td>
</tr>
<tr>
<td>September 11</td>
<td>Treaty of Kars ratified in Yerevan, Armenia.</td>
</tr>
<tr>
<td>June 16</td>
<td>The Russian Civil War ends.</td>
</tr>
<tr>
<td>July 24</td>
<td>Treaty of Lausanne between the Allies and Turkey, successor State to the Ottoman Empire. It supersedes the Treaty of Sèvres.</td>
</tr>
<tr>
<td>January 27</td>
<td>Treaty of Rome between Italy and Yugoslavia. Fiume is annexed by Italy and the neighboring town of Sušak is assigned to Yugoslavia.</td>
</tr>
<tr>
<td>October 3</td>
<td>Germany makes final reparations payments.</td>
</tr>
</tbody>
</table>

**Timeline of events preceding World War II**

**1918**

October 29

Start of the German Revolution.

November 11

The Armistice with Germany marks the end of World War I. German troops evacuate occupied territories and Allied troops subsequently move in and occupy the German Rhineland.

December 27

Start of the Greater Poland Uprising against German rule.

**1919**

January 4–15

The Spartacist uprising takes place and is crushed by the German government, marking the end of the German Revolution.

January 18
Opening of the Paris Peace Conference to negotiate peace treaties between the belligerents of World War I.

January 31

Battle of George Square takes place in Glasgow, the British Army is called in to quell a strike for a 40 hour work week.

February

The Polish–Soviet War begins with border clashes between the two states.

March 2

Foundation of the Third International, or Comintern in Moscow. Comintern's stated aim is to create a global Soviet republic.

March 12

The Austrian Constituent National Assembly demands Austria's integration to Germany.

March 21

Proclamation of the communist Hungarian Soviet Republic.

May 15

The Turkish War of Independence begins as Greek troops land in Smyrna.

June 28

Germany and the Allied powers sign the Treaty of Versailles after six months of negotiations. The German armed forces are limited in size to 100,000 personnel and Germany is ordered to pay large reparations for war damages. The United States signed the treaty but did not ratify it, later making a separate peace treaty with Germany.

July

An unknown corporal named Adolf Hitler infiltrates the German Workers' Party (the precursor of the Nazi Party) at the behest of the German Reichswehr.

August 1

Fall of the short-lived Hungarian Soviet Republic.
September 10

German Austria signs the Treaty of Saint-Germain. The peace treaty with the Allies regulates the borders of Austria, forbids union with Germany and German Austria has to change its name to Austria. The United States did not ratify the treaty and later makes a separate peace treaty with Austria.

September 12

Gabriele D'Annunzio leads a force of Italian nationalist irregulars in the seizure of the disputed city of Fiume (Rijeka).

November 27

Bulgaria signs the Treaty of Neuilly-sur-Seine. The peace treaty with the Allies regulates the borders of Bulgaria, the Bulgarian army is reduced to 20,000 men and Bulgaria is ordered to pay war reparations.

1920

January 10

Creation of the Free City of Danzig which was approved neither by Germany nor Poland.

January 21

The Paris Peace Conference comes to an end with the inaugural General Assembly of the League of Nations. Although one of the victors of World War I, the United States never joins the League.

March

The failed right-wing Kapp Putsch takes place against the German government. The German military remains passive and the putsch is defeated by a general strike.

The German Ruhr Uprising, spurred by the general strike against the Kapp Putsch, is crushed by the German military.

June 4

Hungary signs the Treaty of Trianon with the Allied powers. The treaty regulated the status of an independent Hungarian state and defined its borders. The United States did not ratify the treaty and later makes a separate peace treaty with Hungary.
August 10

Turkey signs the Treaty of Sèvres with the Allied powers (except the US, which never declared war on Turkey). The treaty partitions the Ottoman Empire and the Turkish armed forces are reduced in size. Greece did not accept the borders as drawn up in the treaty and did not sign it. The Treaty of Sèvres was annulled in the course of the Turkish War of Independence and the parties signed and ratified the superseding Treaty of Lausanne in 1923.

October

Żeligowski's Mutiny, a Polish force led by General Lucjan Żeligowski capture Vilnius, officially without support from the Polish state

November

Franklin D. Roosevelt is defeated for the office of Vice President of the United States by Massachusetts Governor Calvin Coolidge.

December 24

Bloody Christmas: Italy occupies Fiume after five days of resistance from Gabriele D'Annunzio's legionnaires.

1921

March 7–17

Red Army mutineers and Russian civilians seize the strategic city of Kronstadt in the Kronstadt Rebellion, demanding expanded civilian rights and an end to the Bolshevik monopoly on Soviet politics. After several days and several thousand casualties, the rebellion is crushed by Bolshevik forces from neighboring Petrograd.

March 18

The Polish–Soviet War ends with the Peace of Riga.

April 24

The Fiuman electorate approves the idea of a Free State of Fiume.

August 25
The U.S.–German Peace Treaty and the U.S.–Austrian Peace Treaty are signed, marking the formal end of the state of war between the two states and the United States instead of the Treaty of Versailles and the Treaty of Saint-Germain that were not ratified by the United States.

August 29

The U.S.–Hungarian Peace Treaty is signed, marking the formal end of the state of war between the two states instead of the Treaty of Trianon that was not ratified by the United States.

November 9

Foundation of the Italian National Fascist Party by Benito Mussolini during the Third Fascist Congress in Rome.

1922

February 6

The Washington Naval Conference ends with the signing of the Washington Naval Treaty by the United Kingdom, the United States, Japan, France, and Italy. The signing parties agree to limit the size of their naval forces.

March

The first German officers travel to the Soviet Union for the purposes of military cooperation between Germany and the Soviet Union.

April 16

Germany and the Soviet Union sign the Treaty of Rapallo, re-establishing diplomatic relations, renouncing financial claims on each other and pledge future cooperation.

August 13

Gabriele D'Annunzio, one of Mussolini's rivals, falls out of a window (either pushed or fell while intoxicated), injuring him severely.

October

The Russian Civil War (ongoing since 7 November 1917) ends in Bolshevik victory with the defeat of the last White forces in Siberia.
October 11

Armistice of Mudanya is signed in the Turkish War of Independence.

October 29

Fascist leader Benito Mussolini is appointed prime minister of Italy by king Victor Emmanuel III after the March on Rome.

November 1

The Grand National Assembly of Turkey abolishes the Ottoman Sultanate.

1923

The Nationalist Kuomintang party and the Communist Party of China form the First United Front to end warlordism in China.

January 11

France and Belgium occupy the Ruhr in an effort to compel Germany to step up its payments of war reparations.

June

The great inflation of 1923, the value of the German mark is destroyed.

July 24

The Treaty of Lausanne, settling the boundaries of modern Turkey, is signed in Switzerland by Turkey and the Entente powers. It marks the end of the Turkish War of Independence and replaces the earlier Treaty of Sèvres.

August 31

The Corfu incident: Italy bombards and occupies the Greek island of Corfu seeking to pressure Greece to pay reparations for the murder of an Italian general in Greece.

September 27
The Corfu incident ends; Italian troops withdraw after the Conference of Ambassadors rules in favor of Italian demands of reparations from Greece.

October 29

Turkey officially becomes a Republic following the dissolution of the Ottoman Empire.

November 8

The Beer Hall Putsch takes place, in which Adolf Hitler unsuccessfully leads the Nazis in an attempt to overthrow the German government. It is crushed by police the next day.

1924

January 21

Leader of the Soviet Union Vladimir Lenin dies, and Joseph Stalin begins purging rivals to clear the way for his dictatorship.

February 1

The United Kingdom extends diplomatic recognition to the Soviet Union.

March 16

Italy annexes the Free State of Fiume

April 1

Adolf Hitler is sentenced to 5 years in prison for his participation in the Beer Hall Putsch (he serves only 8 months).

April 6

Fascists win elections in Italy with a 2/3 majority.

June 10

Italian Fascists kidnap and kill socialist leader Giacomo Matteotti in Rome.
August 16

The Dawes Plan is accepted. It ends the Allied occupation of the Ruhr and sets a staggered payment plan for Germany's payment of war reparations.

August 18

France begins withdrawing its troops from the Ruhr in Germany.

1925

May 12

Retired Field Marshal Paul Von Hindenburg is elected President of Germany.

July 18

Hitler's autobiographical manifesto Mein Kampf is published.

December 1

The Locarno Treaties are signed in London (they are ratified 14 September 1926). The treaties settle the borders of western Europe and normalize relations between Germany and the Allied powers of western Europe.

1926

January 3

Theodoros Pangalos declares himself dictator of Greece.

January 31

British and Belgian troops leave Cologne, Germany.

April 4

Greek dictator Theodoros Pangalos is elected president.
The Treaty of Berlin is signed by Germany and the Soviet Union, which declares neutrality if either country is attacked within the next five years.

September 8

Germany joins the League of Nations.

December 25

Emperor Taishō dies and his son Hirohito becomes the Emperor of Japan.

1927

April 12

The Shanghai massacre of 300-5,000 communists, perpetrated by the Kuomintang, marks the end of the First United Front and the beginning of the Chinese Civil War.

May 20

Saudi Arabia and the United Kingdom sign the Treaty of Jeddah.

June 7

Peter Voikov, Soviet ambassador to Warsaw, is assassinated by a White movement activist.

November 12

Leon Trotsky is expelled from the Soviet Communist Party, leaving Joseph Stalin with undisputed control of the Soviet Union.

December 14

Iraq gains independence from the United Kingdom.

1928

May 3

The Jinan Incident begins, a limited armed conflict between the Republic of China and Japan.
May 28

Foundation of the Chinese Red Army.

June 4

Huanggutun Incident: Japanese agents assassinate the Chinese warlord Zhang Zuolin.

August 2

Italy and Ethiopia sign the Italo-Ethiopian Treaty, pledging cooperation and friendship.

August 27

The Kellogg-Briand Pact is signed in Paris by the major powers of the world. The treaty outlaws aggressive warfare.

October 1

The Soviet Union launches the first five-year plan, an economic effort to increase industrialization.

1929

February 9

Litvinov's Pact is signed in Moscow by the Soviet Union, Poland, Estonia, Romania and Latvia. The Pact outlaws aggressive warfare along the lines of the Kellog-Briand Pact.

February 11

Italy and the Holy See sign the Lateran Treaty, normalizing relations between the Vatican and Italy.

March 4

Herbert Hoover becomes President of the United States.

March 28

Japan withdraws troops from China, ending the Jinan Incident.

April 3
Persia signs Litvinov's Pact.

June 7

The Lateran Treaty is ratified, making the Vatican City a sovereign state.

July 24

The Kellogg-Briand Pact goes into effect.

August 31

The Young Plan, which sets the total World War I reparations owed by Germany at US$26,350,000,000 to be paid over a period of 58½ years, is finalized. It replaces the earlier Dawes Plan.

October 29

The Great Depression begins with the Wall Street Crash.

1930

April 22

The United Kingdom, United States, France, Italy and Japan sign the London Naval Treaty regulating submarine warfare and limiting naval shipbuilding.

June 30

France withdraws its remaining troops from the Rhineland ending the occupation of the Rhineland.

September 14

German election results in the Nazis becoming the second-largest party in the Reichstag.

1931

May 19

Launching of the first Deutschland-class cruiser, Deutschland. The construction of the ship causes consternation abroad as it was expected that the restriction of 10,000 tons displacement for these ships would limit the German Navy to coastal defense vessels, not ships capable of warfare on the open sea.
September 18

Mukden Incident: the Japanese stage a false flag bombing against a Japanese-owned railroad in the Chinese region of Manchuria, blaming Chinese dissidents for the attack, an incident that many claim is the official start of what would become the Second World War.

September 19

Using the Mukden Incident as a pretext, the Japanese invade Manchuria.

1932

The Soviet famine of 1932–33, also known as the Holodomor begins, caused in part by the collectivization of agriculture of the first five-year plan.

January 7

The Stimson Doctrine is proclaimed by United States Secretary of State Henry L. Stimson in response to Japan invading Manchuria. The Doctrine holds that the United States government will not recognize border changes that are made by force.

January 28

January 28 Incident: using a flare-up of anti-Japanese violence as a pretext, the Japanese attack Shanghai, China. Fighting ends on March 6, and on May 5 a ceasefire agreement is signed wherein Shanghai is made a demilitarized zone.

February 27

Fighting between China and Japan in Manchuria ends with Japan in control of Manchuria.

March 1

Japan creates the puppet state Manchukuo out of occupied Manchuria.

April 10

Paul von Hindenburg is reelected President of Germany, defeating Adolf Hitler in a run-off.

May 30
Chancellor of Germany Heinrich Brüning resigns. President Hindenburg asks Franz von Papen to form a new government.

July 25

Soviet–Polish Non-Aggression Pact is signed with it being initially effective for three years.

August 30

Hermann Göring is elected chairman of the German Senate.

November 21

President Hindenburg begins talking to Hitler about forming a new government.

December 3

Hindenburg names Kurt von Schleicher Chancellor of Germany.

1933

January 1

Defense of the Great Wall: Japan attacks the fortified eastern end of the Great Wall of China in Rehe Province in Inner Mongolia.

January 30

Hitler is appointed Chancellor of Germany by President Hindenburg.

February 27

Germany's parliament building the Reichstag is set on fire.

February 28

The Reichstag Fire Decree is passed, nullifying many German civil liberties.

March 4
Franklin Delano Roosevelt is inaugurated as President of the United States.

March 20

Germany's first concentration camp, Dachau, is completed.

March 23

The Reichstag passes the Enabling Act, making Adolf Hitler dictator of Germany.

March 24

Anti-Nazi boycott of 1933

March 27

Japan leaves the League of Nations over the League of Nations' Lytton Report that found that Manchuria belongs to China and that Manchukuo was not a truly independent state.

April 1

Germans are told to boycott Jewish shops and businesses.

April 26

The Gestapo secret police is established in Germany.

May 2

Hitler outlaws trade unions.

May 15

Official formation of the Luftwaffe, the German air force built in secret in violation of the Treaty of Versailles.

May 31

The Tanggu Truce is signed between China and Japan, setting the ceasefire conditions between the two states after the Japanese occupation of Manchuria. China accedes to all Japanese demands, creating a large demilitarized zone inside Chinese territory.

June 21

1260
All non-Nazi parties are banned in Germany.

July 14

The Nazi party becomes the official party of Germany.

August 25

Haavara Agreement: The agreement was designed to help facilitate the emigration of German Jews to Palestine.

September 12

Leó Szilárd conceives the idea of the nuclear chain reaction.

October 19

Germany leaves the League of Nations.

November 24

Homeless, alcoholic, and unemployed sent to Nazi concentration camps.

1934

January 26

Germany and Poland sign the 10 year German-Polish Non-Aggression Pact.

February 12–16

The Austrian Civil War is fought, ending with Austrofascist victory.

February 9

Balkan Pact, a military alliance is signed between Greece, Turkey, Romania and Yugoslavia

March 20

All German police forces come under the command of Heinrich Himmler.
May 5

Soviet-Polish Non-Aggression Pact is extended to December 31, 1945.

June 30

Night of the Long Knives in Germany. Potential rivals to Hitler within the Nazi Party, including SA leader Ernst Röhm and prominent anti-Nazi conservatives such as, former Chancellor Kurt von Schleicher, are killed by the SS and the Gestapo.

July 20

The SS becomes an organization independent of the Nazi Party, reporting directly to Adolf Hitler.

July 25

Austrian Nazis assassinate Engelbert Dollfuss during the failed July Putsch against the Austrian government.

August 2

Upon the death of President Hindenburg, Hitler makes himself Führer of Germany, becoming Head of State as well as Chancellor.

August 8

Members of the Wehrmacht begin swearing a personal oath of loyalty to Hitler instead of to the German constitution.

September

The Soviet Union joins the League of Nations.

October 16

Beginning of the Long March where the Chinese Red Army retreats to evade the pursuit of the Kuomintang forces.
Sergey Kirov, head of the Leningrad communist party, is murdered by an unknown assailant, precipitating a wave of repression in the Soviet Union.

December 5

The Abyssinia Crisis begins with the Walwal incident, an armed clash between Italian and Ethiopian troops on the border of Ethiopia.

December 29


1935

January 7

The League of Nations approves the results of the Saar plebiscite, which allows Saar to be incorporated into German borders.

June 18

The Anglo-German Naval Agreement is signed by Germany and the United Kingdom. The agreement allows Germany to build a fleet that's 35% the tonnage of the British fleet. In this way, the British hope to limit German naval rearmament.

August 31

The Neutrality Act of 1935 is passed in the United States imposing a general embargo on trading in arms and war materials with all parties in a war and it also declared that American citizens traveling on ships of warring nations traveled at their own risk.

September 15

The Reichstag passes the Nuremberg Laws, institutionalizing discrimination against Jews and providing the legal framework for the systematic persecution of Jews in Germany.

October 3
Italy invades Ethiopia, beginning the Second Italo–Abyssinian War. League denounces Italy and calls for an oil embargo that fails.

November 14

Final British General election for over a decade. Stanley Baldwin replaces Ramsay MacDonald as Prime Minister.

1936

January

George V, King of the British Empire, is euthanized by his doctors. David, Prince of Wales becomes King Edward VIII.

February 6

Germany hosts the 1936 Winter Olympics in Garmisch-Partenkirchen, Bavaria.

March 7

In violation of the Treaty of Versailles, Germany seizes the Rhineland.

After the Rhineland move Hitler met separately with French journalist Bertrand de Jouvenal and British analyst Arnold J. Toynbee emphasizing his limited expansionist aim of building a greater German nation, and his desire for British understanding and cooperation.

King Edward VIII, over the head of the Baldwin Government, orders the military to stand down in relation to the move.

March 25

The Second London Naval Treaty is signed by the United Kingdom, United States, and France. Italy and Japan each declined to sign this treaty.

May 5

Italian troops march into the Ethiopian capital, Addis Ababa, marking the end of the Second Italo–Abyssinian War.

June 3
Luftwaffe Chief of Staff General Walther Wever loses his life in an air crash, ending any hope for the Luftwaffe to ever have a strategic bombing force similar to the Allies.

July 17

The failed Spanish coup of July 1936 by Nationalist forces marks the beginning of the Spanish Civil War.

August 1

Germany hosts the 1936 Summer Olympics in Berlin.

October

The Great Purge commences in the Soviet Union with widespread repression of suspected opponents of the regime. The purge leads to the imprisonment and death of many military officers, weakening the Soviet Armed Forces ahead of World War II.

October 18

Göring is made head of the German Four Year Plan, an effort to make Germany self-sufficient and increase armaments.

November 14

Suiyuan Campaign begins as Japanese-backed Mongolian troops attack the Chinese garrison at Hongort.

November 15

The aerial German Condor Legion goes into action for the first time in the Spanish Civil War in support of the Nationalist side.

November 25

The Anti-Comintern Pact is signed by Japan and Germany. The signing parties agree to go to war with the Soviet Union if one of the signatories is attacked by the Soviet Union.

December 1

Hitler makes it mandatory for all males between the ages 10-18 to join the Hitler Youth.
Kuomintang marshal Zhang Xueliang kidnaps Chinese leader Chiang Kai-Shek in order to compel the Kuomintang to make a truce with the Chinese Communist party for the purpose of fighting the invading Japanese.

Edward VIII is forced to abdicate and is succeeded by Albert, Duke of York, who assumes the name King George VI.

December 23

The first 3,000 men of the Italian expeditionary force (later named Corpo Truppe Volontarie) lands in Cadiz in support of the Nationalist side in the Spanish Civil War.

December 24

The Second United Front is formed between the Chinese Communist party and the Kuomintang, temporarily suspending the Chinese Civil War for the sake of fighting the Japanese.

1937

January 20

President Roosevelt begins his second term.

May 28

Neville Chamberlain becomes Prime Minister of the United Kingdom.

July 7

The Marco Polo Bridge Incident occurs, beginning the Second Sino-Japanese War.

August 13

Second Sino-Japanese War: Battle of Shanghai commences.

October 5

President Roosevelt gives the Quarantine Speech outlining a move away from neutrality and towards "quarantining" all aggressors.

November 6
Italy joins the Anti-Comintern Pact.

November 26

Second Sino-Japanese War: Battle of Shanghai ends in Japanese victory as Chinese forces evacuate the city.

December 1

Second Sino-Japanese War: Battle of Nanking commences as Japanese forces attack the city.

December 8

Japan established the puppet state of Mengjiang in the Inner Mongolia region of the Republic of China.

December 11

Italy leaves the League of Nations.

December 12

The USS Panay incident occurs, where Japan attacked the American gunboat Panay while she was anchored in the Yangtze River.

December 13


1938

January 26

The Allison incident occurs further straining relations between Japan and the United States.

March 6


March 13

Austria is annexed by Germany.
March 24

Second Sino-Japanese War: Battle of Taierzhuang commences. The battle ends with Chinese victory on 7 April after intense house-to-house fighting inside the city of Taierzhuang.

Second Sino-Japanese War: Battle of Xuzhou begins, and ends in Japanese victory on May 1 as Chinese troops break out from the encircled city.

July 6–16

Évian Conference: The United States and the United Kingdom refuse to accept any more Jewish refugees.

July 29

The Soviet–Japanese border conflicts begin with the Battle of Lake Khasan.

August

Soviet Union wins the Battle of Lake Khasan against Japan.

September 27

U.S. President Roosevelt sends a letter to German Führer Adolf Hitler seeking peace.

September 30

The Munich Agreement is signed by Germany, France, the United Kingdom, and Italy. The agreement allows Germany to annex the Czechoslovak Sudetenland area in exchange for peace in an attempt to appease Hitler.

Also in 1938, the Polish government opportunistically undertook a hostile action against the Czechoslovak state as weakened by the Munich Agreement and annexed a small piece of territory on its borders.

October 5

Germany invalidates the passports of all its Jewish citizens who are reissued passports with the letter "J" stamped in red. This change was made after requests by Sweden and Switzerland who wanted a way of easily denying Jews entry into their countries.

November 7
Polish Jew Herschel Grynszpan mortally wounded German consular aide Ernst vom Rath in Paris.

November 9

Following vom Rath's death, the Kristallnacht pogrom begins in Germany; thousands of Jewish shops and synagogues are smashed, looted, burned, and destroyed throughout the country.

1939

January 25

A uranium atom is split for the first time at Columbia University in the United States.

January 27

Hitler orders Plan Z, a 5-year naval expansion programme intended to provide for a huge German fleet capable of defeating the Royal Navy by 1944. The Kriegsmarine is given the first priority on the allotment of German economic resources. This is the first and only time the Kriegsmarine is given the first priority in the history of the Third Reich.

March 14

The pro-German Slovak Republic is created.

Carpatho-Ukraine is created, which Hungary invades that same day.

March 15

Germany occupies and annexes Bohemia and Moravia-Silesia in violation of the Munich Agreement. The Czechs do not attempt to put up any organized resistance, having lost their main defensive line with the annexation of the Sudetenland.

Germany establishes the Protectorate of Bohemia and Moravia. The Second Czechoslovak Republic is dissolved.

March 16

Hungary annexes the Carpatho-Ukraine.

March 20
German Foreign Minister Joachim von Ribbentrop delivers an oral ultimatum to Lithuania, demanding that it cede the Klaipėda Region (German name Memel) to Germany.

March 21

Hitler demands the return of the Free City of Danzig to Germany.

March 23

German–Romanian Treaty for the Development of Economic Relations between the Two Countries is signed.

Germany annexes the Klaipėda Region.

Germany and Slovakia sign the Treaty on the protective relationship between Germany and the Slovak State, creating the German Zone of Protection in Slovakia.

The Slovak–Hungarian War begins.

March 31

The United Kingdom and France offer a guarantee of Polish independence.

The Slovak–Hungarian War ends.

April 1

The Spanish Civil War ends in Nationalist victory. Spain becomes a dictatorship with Francisco Franco as the head of the new government.

April 3

Hitler orders the German military to start planning for Fall Weiss, the codename for the attack on Poland, planned to be launched on August 25, 1939.

April 4

Hungary and Slovakia sign the Budapest Treaty, handing over a strip of eastern Slovak territory to Hungary.

April 7–12
Italy invades Albania with little in the way of military resistance. Albania is later made part of Italy through a personal union of the Italian and Albanian crown.

April 14

U.S. President Roosevelt sends letter to German Chancellor Hitler and Italian Prime Minister Mussolini seeking peace.

April 18

The Soviet Union proposes a tripartite alliance with the United Kingdom and France. It is rejected.

April 28

In a speech before the Reichstag, Hitler renounces the Anglo-German Naval Agreement and the German–Polish Non-Aggression Pact.

May 11

Soviet–Japanese border conflicts: The Battle of Khalkhin Gol begins with Japan and Manchukuo against the Soviet Union and Mongolia. The battle ends in Soviet victory on September 16, influencing the Japanese not to seek further conflict with the Soviets, but to turn towards the Pacific holdings of the Euro-American powers instead.

May 17

Sweden, Norway, and Finland reject Germany's offer of non-aggression pacts.

May 22

The Pact of Steel, known formally as the "Pact of Friendship and Alliance between Germany and Italy", is signed by Fascist Italy and Nazi Germany. The Pact declares further cooperation between the two powers, but in a secret supplement the Pact is detailed as a military alliance.

June 14

The Tientsin Incident occurs, in which the Japanese blockade the British concession in the North China Treaty Port of Tientsin.

July 10
Prime Minister Neville Chamberlain reaffirms support for Poland and makes it clear that Britain did not view Free City of Danzig as being an internal German-Polish affair and would intervene on behalf of Poland if hostilities broke out between the two countries.

August 2

The Einstein-Szilárd letter is sent to President Roosevelt. Written by Leó Szilárd and signed by Albert Einstein, it warned of the danger that Germany might develop atomic bombs. This letter prompted action by Roosevelt and eventually resulted in the Manhattan Project.

August 23

The Molotov–Ribbentrop Pact is signed between Nazi Germany and the Soviet Union, with secret provisions for the division of Eastern Europe – joint occupation of Poland and Soviet occupation of the Baltic States, Finland and Bessarabia. This protocol removes the threat of Soviet intervention during the German invasion of Poland.

August 25

In response to a message from Mussolini that Italy will not honor the Pact of Steel if Germany attacks Poland, Hitler delays the launch of the invasion by five days to provide more time to secure British and French neutrality.

August 30

German ultimatum to Poland concerning the Polish Corridor and the Free City of Danzig.

September 1

Without response to its ultimatum, Germany invades Poland, start of World War II (the Soviet Union invades Poland on September 17).

Timeline of the Muslim presence in the Iberian Peninsula
Conquest (711–756)

- 711 – A Berber force of about 7,000 soldiers under the Berber general Tariq ibn Ziyad, loyal to the Umayyad Emir of Damascus, Al-Walid I, enters the Iberian peninsula from North Africa.
  - At the Battle of Guadalete Tariq ibn Ziyad defeats King Roderic.
- 712 – The Muslim governor of Northern Africa, Musa ibn Nusayr, follows Tariq ibn Ziyad with an army of 18,000 Arabs. He takes Medina-Sidonia, Seville and Mértola.
- 713 – Abd al-Aziz ibn Musa, Musa ibn Nusair's son, takes Jaén, Murcia, Granada, Sagunto.
- 714 – First Umayyad campaigns in the lower Ebro valley and southeast part of the Iberian Peninsula.
  - Abd al-Aziz ibn Musa takes Évora, Santarém and Coimbra.
- 715 – Abd al-Aziz ibn Musa is left in charge and makes his capital the city of Seville. The Umayyad Caliph Sulayman ibn Abd al-Malik, orders Abd al-Aziz ibn Musa assassinated.
- 717 – Córdoba becomes the capital of Muslim Al-Andalus.
- 718 – Pelayo, a Christian Asturian noble and possibly (but not certainly) comrade-in-arms of King Rodrigo at the Battle of Guadalete, leads the fight against the Umayyads in the Asturian region.
- 720 – The Umayyads (Arabs) conquer Barcelona and Narbonne, Septimania.
- 721 – A combined force of Aquitanians and Franks under Duke Odo of Aquitaine defeat an Umayyad army at the Battle of Toulouse.
- 725 – Anbasa ibn Suhaym al-Kalbi raids Autun in Burgundy, Frankish Kingdom.
- 731 – Berbers allied of Odo of Aquitaine rebel in Cerdanya, but the rebellion is suppressed by Abdul Rahman Al Ghafiqi.
  - Frankish commander Charles Martel and Odo defeat an Umayyad army at the Battle of Tours-Poitiers, killing Abdul Rahman Al Ghafiqi.
- 735 – Arabs take Arles in the Rhône Valley.
- 739 – Berbers revolt in North Africa, thereafter expanding to Iberia.
  - Rebels in North Africa defeat a Syrian force and kill its commander Kulthum.
  - Revolt drives Muslim army out of Galicia.
- 740 – Berbers rebel against the ethnically exclusive Arab Umayyad Caliphate and refuse to support them with tax revenues.
- 741 – The 10,000 survivors of Kulthum's force arrive in Iberia under a new leader, Talaba ibn Salama.
- 742 – Internal conflict in Al-Andalus continues for the next 4 years.
- 755 – Abd ar-Rahman I of the Umayyad dynasty flees to Iberia to escape the Abbasids.
- 756 – Abd ar-Rahman I defeats Yusuf al-Fihri outside Córdoba.

**The Umayyad Emirate of Córdoba (756–929)**

- 756 – Abd ar-Rahman I proclaims himself Emir of Córdoba.
- 759 – The Andalusis lose the city of Narbonne, last Muslim stronghold north of the Pyrenees.
- 764 – Abd ar-Rahman I takes Toledo from Hisham ibn Urwa.
- 771 – Syrians under Abd al-Ghaffar rebel against Abd ar-Rahman I, but the latter defeats the Syrians on the river Bembezar in 774.
- 777 – Abd ar-Rahman I suppresses an Abbasid-inspired revolt.
- 778 – The Franks led by Charlemagne attack Zaragoza, but are forced to withdraw empty-handed.
- 785 – Building of the Great Mosque of Córdoba begins on the grounds of a Visigothic church; it is completed in 976.
- 788 – Death of Abd ar-Rahman I, founder of the independent Umayyad Emirate of Córdoba. His successor is Hisham I.
- 791 – Alfonso II becomes King of Asturias in Oviedo and takes a number of Andalusi strongholds and settles the lands south of the Douro River.
- 791 – Battle of the Burbia River, where the Umayyad Cordovans defeat the Asturians.
  - A Muslim force raids into Galicia.
- 792 – Hisham I, Emir of Córdoba, calls for a Jihad against the "infidels" in the Marca Hispanica and Gothia (eastern Pyrenees).
- 794 – Asturians defeat the Umayyad Cordovans at the Battle of Lutos.
- 795 – An Umayyad force occupies Astorga.
- 796 – Al-Hakam I becomes Emir of Córdoba.
- 798 – In a raid across western al-Andalus, Alfonso II of Asturias captures and sacks Lisbon, but does not retain it.
- 799 – Basques revolt and kill the local Cordovan governor in Pamplona (Mutarrif ibn-Musa).
- 800 – Charlemagne takes Barcelona. He is granted the title of "Holy Roman Emperor" by Pope Leo III in order to guarantee his protection of Rome against the invading Lombards.
- 801 – William of Gellone and Louis the Pious, Charlemagne's son, take Barcelona from Andalusi lords.
- 806 – Frankish conquest of Pamplona.
- 808 – Franks fail to take Tortosa.
- 809 – An Umayyad prince defeats and executes Tumlus, a Muslim rebel who had seized power in Lisbon some years before.
- 811 – Charlemagne fails to take control of Tarragona; "Hispanic March" (designation until 874) established to the south of Barcelona.
- 813 – The grave of James the Apostle is 'revealed' near Santiago de Compostela, in Galicia.
- 816 – Forces of the Emirate of Córdoba under Abd al-Karim ibn Abd al-Wahid defeat a force loyal to the Kingdom of Francia under Balask al-Yalasqi.
- 822 – Abd-ar-Rahman II becomes Emir of Córdoba.
- 824 – Basques destroy a Carolingian army at the second Battle of Roncesvalles. Kingdom of Pamplona established.
- 825 – Andalusian forces attempt to invade Christian territory from Coimbra and Viseu but are driven back.
- 827 – Bernt of Septimania holds Barcelona against Gothic rebels who have Umayyad assistance.
- 829 – Another insurrection in Mérida.
- 839 – Alfonso II of Asturias commands a military force in the region of Viseu.
- 844 – Vikings raid the Galician estuaries, are defeated by Ramiro I, attack Lisbon, and sack Seville, but are shortly afterwards wiped out by a Córdoban relief army.
  - Battle of Clavijo, a fictitious battle between Christians led by Ramiro I of Asturias and Muslims, where St. James is claimed to have aided a Christian Army.
- 848 – William, son of Bernat of Septimania, seizes Barcelona.
- 850–859 – Perfectus, a Christian priest in Andalusi Córdoba, is beheaded after refusing to retract numerous insults hurled at Muhammad. Numerous other priests, monks, and laity would follow.
  - Forty-eight Christian men and women are decapitated for refusing to convert or recurrently blasphemying Muhammad—Martyrs of Córdoba.
- 852 – Death of Abd at-Rahman II.
  - Muhammad I becomes Emir of Córdoba.
- 859 – Vikings raid the Iberian coast. They capture and ransom King García Íñiguez of Pamplona.
- 859 – Ordoño I of Asturias defeats Musa ibn Musa at Albelda.
- 871 – The city of Coimbra is taken from the Moors. Hermenegildo Mendes is made Count of Coimbra.
- 873 – Over the next 25 years Wilfred the Hairy, Count of Barcelona, sets up a Christian principality with a certain degree of independence from the Frankish kings.
- 886 – Al-Mundhir becomes Emir of Córdoba.
Revolts in Al-Andalus continue till 912

- 888 – Abdallah ibn Muhammad becomes Emir of Córdoba.
- 905 – Sancho I of Pamplona usurps the Basque kingdom of Pamplona with the help of Alfonso III of León, Raymond I, Count of Pallars and Ribagorza and the Banu Qasi.
- 912 – Abd al-Rahman III becomes the Emir of Córdoba. Every spring, Muslims launch raiding campaigns against the Christian frontier.
- 913 – An expedition commanded by Ordoño II of León takes Évora (Talavera) from the Muslims.
  - The capital city of the Kingdom of Asturias is moved from Oviedo to León, becomes Kingdom of León.
- 916 – Ordoño II of León is defeated by Emir Abd al-Rahman III in Valdejunquera.
- 917 – Battle of San Esteban de Gormaz. Ordoño II defeats an army under Emir Abd al-Rahman III.
- 919 – The Muslims again attack the city of San Esteban de Gormaz at the Battle of San Esteban de Gormaz (919)
  - Pope John X recognizes the orthodoxy and legitimacy of the Visigothic Liturgy maintained in the Mozarabic rite.
- 920 – Battle of Valdejunquera, where the armies of Abd al-Rahman III defeat the armies of the Kingdom of León.
- 920 – Muslim forces under the command of Abd al-Rahman III take the city of San Esteban de Gormaz
- 920 – Muslim forces cross the Pyrenees, enter Gascony, and reach as far as the gates of Toulouse. The garrison of Muez is killed.
- 924 – The city of Pamplona is destroyed by forces led by Abd al-Rahman III.

**The Umayyad Caliphate (929–1031)**

- 929 – Abd al-Rahman III, faced with the threat of invasion by the Fatimids, proclaims himself Caliph of Córdoba, breaking all ties with the Abbasid Caliphate in Baghdad. Under the reign of Abd al-Rahman III Muslim Al-Andalus reaches its greatest height before its slow decline over the next four centuries.
- 930 – Over the next 20 years Ramiro II of León, defeats Abd al-Rahman III at Simancas, Osma, and Talavera.
- 933 – Battle of Osma where Castilian–Leónese troops, under Fernán González of Castile, defeat the Muslim army of Abd al-Rahman III.
- 939 – Battle of Simancas where Ramiro II of León defeats Abd al-Rahman III. Christians defeat Al-nasir at Alhandega.
*Madrid is recaptured from Muslim forces. The encounter between the two rulers finally took place in 939, when, at the so-called ditch of Simancas (Shant Mankus), Ramiro II of León severely defeated the Muslims, and Abd al-Rahman III narrowly escapes with his life. After that defeat Abd al-Rahman III resolved never to take personal charge of another expedition. But Madrid recaptured by Muslims in 940.*

- 953 – Emperor Otto I sends representatives to Córdoba to ask Caliph Abd al-Rahman III to call off some Muslim raiders who had set themselves up in Alpine passes and are attacking merchant caravans going in and out of Italy.
  - Big Moorish incursion in Galicia.
- 955 – Ordoño III of León attacks Lisbon.
- 961 – Al-Hakam II becomes Umayyad Caliph of Córdoba.
- 976 – Caliph Al-Hakam II dies, and Al-Mansur takes over in the name of his protégé Hisham II, becoming a military dictator usurping caliphal powers and launching a big number of offensive campaigns against the Christians. The Christians take advantage of the resulting confusion and commence raids into Muslim territory.
  - Al-Mansur sacks Barcelona.
- 977 – Al-Mansur volunteers to lead the army against the Christians, and is successful.
- 978 – Leonese forces under Garci Fernández and Ramiro III of León suffer the worst in a string of defeats at San Esteban de Gormaz (Also defeated at Rueda and Torrevicente), eventually leading to the revolt of the Galacian nobles and the abdication of Ramiro in favor of Bermudo II of León.
  - 981 – Ramiro III of León is defeated by Al-Mansur at Rueda at the Battle of Rueda and is obliged to pay tribute to the Caliph of Córdoba.
- 983 – After failing in a rebellion in the Maghreb, the Berber Chief Zawi ibn Ziri, of the Tunisian royal family, brings a formidable force of Sanhaja horsemen to join Al-Mansur. However, they are not allowed to cross the straits for many years (sometime 1002–1008).
- 985 – Under Al-Mansur and subsequently his son, Christian cities are subjected to numerous raids.
- 985 – Al-Mansur sacks Barcelona.
- 986 – Al-Mansur burns down the monastery of Sant Cugat del Vallès.
• 987 – Al-Mansur lays waste to Christian Coimbra.
  o Al-Mansur seizes the castles north of the Douro River, and arrives at the city of Santiago de Compostela. The city had been evacuated and Al-Mansur burns it to the ground.
  o Al-Mansur has the basilica doors and bells of the Christian shrine of Santiago de Compostela taken to the Córdoba Mosque and has the rest of the Church destroyed.

• 988 – Al-Mansur razes León to the ground. He sacks Leon, Zamora, and Sahagun, and sets fire to the great monasteries of Eslonza and Sahagun.

• 989 – Al-Mansur seizes Osma.

• 995 – Despite stout resistance by the Beni-Gomez clan – Christian counts of Saldaña, Liébana, Carrión, and Zamora – Al-Mansur destroys their capital, the city of Santa Maria de Carrion.

• 997 – Under the leadership of Al-Mansur, Muslim forces march out of the city of Córdoba and head north to capture Christian lands.

• 998 – Wadih, a Slav and the best Andalusian commander of the time, takes Fez in Morocco with a large force.
  o Muslims briefly attempt to establish a garrison at Zamora.

• 1000 – Sancho III of Navarre, inflicts major losses on the Muslims, and nearly clinches a remarkable victory.

• 1000–1033 – Sancho III of Navarre gains control of Aragon and Castile, uniting the three kingdoms. But on his death, he splits the kingdom and leaves Navarre to his son García III of Pamplona, Castile to Fernando I, and Aragon to Ramiro I.

• 1002 – Al-Mansur raids into La Rioja.
  o Al-Mansur dies in the village of Salem.
  o Power in Al-Andalus subsequently divided between the old Arab nobility, the Berber mercenaries, and the Slav slaves.

• 1002–1008 – Al-Mansur’s son Al-Muzaffar conducts annual raids against the Christians.

• 1003 – Moors lay waste to the city of León.

• 1008 – On the death of al-Muzaffar, Abd al-Rahman ibn Al-Mansur, another son of Al-Mansur, takes over the role of unofficial ruler. In winter he leads his army against the Christians.
  o Mohammed II al-Mahdi becomes Umayyad Caliph of Córdoba.
  o The period of anarchy over the next 23 years out of which emerged approximately two dozen taifa states.

• 1009 – Muslims lay waste to León again.
The Berbers are expelled from Córdoba and set up camp at Calatrava. Their Generals nominate another descendant of Abd al-Rahman III – Sulayman al-Mustain – as a rival Caliph.

Suleiman seeks the aid of Count Sancho García of Castile against Mohammed II of Umayyad. The joint Berber-Castilian army defeats the Arab militia of Muhammad II and sacks Córdoba.

Sulaiman al-Mustain becomes Umayyad Caliph of Córdoba as Suleiman II, after deposing Mohammed II.

The Taifa (independent Moorish kingdom) of Badajoz becomes independent of the Caliph of Córdoba and governs the territory between Coimbra and North Alentejo.

1010

Having fled to Toledo, Mohammed II seeks the aid of Ramon Borrell, Count of Barcelona and Urgel. The Catalan army defeats Sulaiman II's Berbers at Aqabat al-Baqar and again near the river Guadiaro (near Ronda).

Mohammed II reclaims Córdoba supported by the Slav General al-Wadih, but is assassinated.

Hisham II is restored as Umayyad Caliph of Córdoba by slave troops of the Caliphate under al-Wahdid.

1012 – Berber forces capture Córdoba and order that half the population be executed.

Sulaiman II is restored as Umayyad Caliph of Córdoba by the Berber armies.

1013 – A Berber reign of terror in Córdoba that kills the deposed Hisham II.

The powerless Sulaiman II is forced to hand out provincial governorships to the Berber chiefs.

Jews are expelled from the Umayyad Caliphate of Córdoba, then ruled by Suleiman II.

Samuel ibn Naghrillah flees to Málaga when Suleiman attacks Córdoba.

Samuel ibn Naghrillah becomes vizier to the Emir of Granada, as does his son, Joseph ibn Naghrela. Many other Jews flee to Granada.

Caliphate of Córdoba begins to break up. Many Taifas (independent Moorish kingdoms) begin to spring up.

1014 – The Berber chief Zawi ibn Ziri – leader of the Sanhaja confederation, and a member of the Tunisian royal family – makes Granada his capital.

1015 – The Emir of Denia, Mujāhid al-ʿĀmirī, sets out from his base in the Balearic Islands with a fleet of 125 ships in an attempt to take Sardinia.

Ali ibn Hammud, Emir of Ceuta, declares himself the rightful Caliph and marches on Córdoba. A Berber general deposes and executes Caliph Suleiman II.

Mujāhid al-ʿĀmirī is dislodged from Sardinia by a force from Genoa and Pisa.
  o The Taifa of the Algarve becomes independent.
1021 – Abd-ar-Rahman IV becomes Umayyad Caliph of Córdoba.
  o Yahya, the son of Ali ibn Hammud al-Nasir, rebels in Málaga with the support of the Berbers.
1022 – Abd-ar-Rahman V becomes Umayyad Caliph of Córdoba with the support of Berber troops.
  o The Taifa (independent Moorish kingdom) of Lisbon emerges. It will be annexed by the Taifa of Badajoz.
1023 – Muhammad III becomes Umayyad Caliph of Córdoba with the support of Berber troops.
  o The Abbadid Emir of Seville, Abu al-Qasim Muhammad ibn Abbad, declares independence from Muhammad III, Umayyad Caliph of Córdoba.
1025 – Abu al-Qasim Muhammad ibn Abbad, Abbadid Emir of Seville, captures two castles at Alafões to the north-west of Viseu.
1027 – Hisham III becomes Umayyad Caliph of Córdoba.
1028 – Alfonso V, king of Asturias and León, lays siege to Viseu but is killed by a bolt from the walls.
  o The Moorish Caliphate of Córdoba falls.

Political fragmentation (1031–1130)

1031 – The Moorish Caliphate of Córdoba falls.
  o Hisham III, the last of the Umayyad Caliphs disappears into obscurity.
1033 – The Taifa (independent Moorish kingdom) of Mértola becomes independent.
1034 – The Leonese destroy a raiding force under Ismail ibn Abbad of Seville. Ismail ibn Abbad flees to Lisbon.
  o Gonçalo Trastemires – a Portuguese frontiersman – captures Montemor castle on the Mondego river.
  o Over the next 28 years Ferdinand I of León takes Coimbra and obliges the Muslims of Toledo, Seville, and Badajoz to pay him tribute. Before his death, he divides his territories between his sons: Castile goes to Sancho II, León to Alfonso VI of León and Castile and Galicia to Garcia II.
  o Bermudo III of León defeats the Moors in César, in the Aveiro region.
1038 – Granadine armies under the vizier wage almost continuous war against their Muslim neighbours, primarily Seville.
1040 – The Taifa of Silves becomes independent.
1043 – Zaragoza and Toledo fight over the border city of Guadalajara. Toledo pays the Navarrese to raid into Zaragoza; similarly, Zaragoza pays the León–Castilians to raid into Toledo. The Christian armies ravage the respective Muslim lands unchecked.

  o Rodrigo Díaz Vivar, whom the Muslims would name "El Cid Campeador" (Lord Winner of Battles) is born in Burgos.

1044 – Abbad III al-Mu'tamid, son of the Abbadid Emir of Seville Abbad II al-Mu'tadid, retakes Mértola, since 1033 an independent Taifa.

1051 – Yusuf ibn Hud, the Banu Hud Emir of Lleida, is paying the Catalans to protect against his own family in Zaragoza.

  o The Taifa of the Algarve is annexed by the Taifa of Seville.

1053 – Emir Al-Mutadid of Seville drives Berbers from Arcos, Morón and Ronda.

1054 – Battle of Atapuerca. The army of Ferdinand I of Castile defeats that of his brother García III of Navarra, near Burgos. Several disaffected Navarrese knights join the Castilians before the battle and one of these men is believed to have killed Garcia. Garcia's son Sancho is proclaimed King on the field of battle and the war continues.

1055 – Emir Al-Mutadid of Seville drives Berbers from Algeciras.

1056 – The Almoravids (al-Murabitun) Dynasty begins its rise to power. This Berber dynasty who would rule North Africa and Islamic Iberia until 1147.

1057 – Emir Al-Mutadid of Seville drives Almoravids from Carmona.

  o Ferdinand I of Castile-León takes Lamego from the Moors.

1058 – Emir Al-Muzaffar al-Aftas (Abu Bekr Muhammad al-Mudaffar – Modafar I of Badajoz, Aftid Dynasty) pays the Christians to leave Badajoz, but not before Ferdinand I of Castile-León takes Viseu.

1060–1063 – Council (Ecumenical Synod) of Santiago de Compostela.

1060 – The heretic Berghouata Berbers set up a Taifa in Ceuta, but are eventually crushed by the Almoravids.

  o Ferdinand I of León imposes an annual tribute on Muslim Zaragoza. Emir Al-Muktadir ibn Hud of Zaragoza drives Slavs from Tortosa when the Tortosans rise against their Slav ruler.

1062 – Ferdinand I of Castile and León invades Muslim Toledo with a large army. Emir Al-Mamun becomes a tributary of Castile. Ferdinand then invades Muslim Badajoz, and extracts tribute from Emir Al-Mutadid of Seville.

1063 – Battle of Graus. During spring, Ramiro I of Aragon besieges Muslim Graus in Zaragozan territory. The Emir al-Muqtadir of Zaragoza leads his army north accompanied by a Castilian contingent under Prince Sancho (the future Sancho II). Rodrigo Díaz de Vivar later known as El Cid is probably in the Castilian contingent. The opposing armies meet and after a protracted struggle Ramiro I is killed and the
Aragonese flee (8 May 1063). Pope Alexander II sends an international force to Spain under his standard bearer William of Montreuil. It includes Italian knights, Normans (Robert Crespin, Baron of Lower Normandy), Frenchmen (William, Count of Poitiers and Duke of Aquitaine), and Iberians (Bishop of Vic; Count Ermengol II of Urgel). At the start of July the expedition besieges Barbastro in the Muslim Kingdom of Lleida. The Emir of Lleida (the brother of Muktadir of Zaragoza) makes no attempt to relieve the siege and after 40 days the defenders are forced to surrender when a large stone falls from the walls and blocks the only water supply. 50,000 inhabitants are massacred or enslaved. Count Ermengol II of Urgel is left as governor on behalf of Sancho Ramirez of Aragon. Seville feels obliged to pay Christians tribute.

- The Taifa of Seville annexes the Taifa of Silves.

1064 – Ferdinand I of León-Castile besieges Muslim Coimbra from 20 January 1064 – 9 July 1064. The Muslim governor who surrendered is allowed to leave with his family, but 5,000 inhabitants are taken captive, and all Muslims are forced out of Portuguese territory across the Mondego river.

- The Mozarabic (Christian) general Sisnando Davides, who led the siege of Coimbra, becomes Count of Coimbra.
- The Hispanic calendar is adopted.

1065 – Civil War in Castile-León. In April Emir Al-Muqtadir of Zaragoza, aided by 500 Sevillian knights, besieges Barbastro. The governor, Count Ermengol II of Urgel, is killed in a sortie, and a few days later the city falls, whereupon the Iberian and French garrison is put to the sword, thus bringing an end to Pope Alexander II's prototype crusade. At around the same time Emir Al-Muqtadir breaks off relationships with Castile, and Ferdinand I leads a punitive expedition into Zaragoza – taking Alquezar – and then into Valencia. Despite him being a tributary of Castile, Emir Mamun of Toledo leads to force in support of his son-in-law Emir Abd al-Malik. Mamun subsequently dethrones Abd al-Malik and incorporates Valencia into the Kingdom of Toledo. Ferdinand falls dangerously ill and retires from the field. King Ferdinand dies in León on 28 December 1065, and his empire is divided between his three sons: Sancho II in Castile, Alfonso VI in León, and Garcia in Galicia.

1066 – Joseph ibn Naghrela, son of the Jewish Vizier Samuel ibn Naghrela Ha-Nagid, invites Al-Mutasim of Almería to come and rule in Granada. The Zirids of Sanhaja defeat the attempt and instigate a pogrom of the Jews in Granada.

- Joseph and other Jews in Granada are attacked and murdered; many escapees flee to the north. "More than 1,500 Jewish families, numbering 4,000 persons, fell in one day, December 30, 1066."

1067 – The Castilian army under Sancho II and the Alferez Rodrigo Díaz de Vivar – already known as El Cid by this time – besiege Zaragoza. The siege is lifted after Emir Al-Muqtadir pays a large ransom and promises tribute. War of the three Sanchos: Castile versus Aragon and Navarre. Aragon severely mauls the Castilians at Viana, however status quo is restored when the Zaragozan Vali of Huesca invades Aragon from the south.
• 1068 – Alfonso VI of León leads a campaign against Badajoz, but withdraws when Emir Mamun ibn Dhi-I-Nun of Toledo intercedes. Badajoz becomes tributary to León. Later the Emir of Badajoz dies and his two sons dispute the succession.

• 1069 – Alfonso VI of León overruns Badajoz early in the year. Seville takes Córdoba. The army consists of an advance guard of 300 horses and a main body of 1000.

• 1071 – Battle of Pedrosa (between Braga and the River Cávado) where García II of Galicia suppresses the rebellion of his Portuguese subjects under Count Nuno Mendes, last count of Portugal of the Vívara Peres House. Count Nuno Mendes is killed and García II of Galicia proclaims himself King of Portugal. Sometime after 18 January 1071 and before May, García II of Galicia is captured by his brother Sancho II of Castile (It is unclear if García was captured in open battle at Santarém or by trickery). García purchases his release and retires to the court of his tributary Al-Mutamid of Seville. Galicia is divided between his brothers Sancho and Alfonso.

• 1073 – The Emir of Granada rejects the Castilian demand for tribute, however, Abbad III al-Mu'tamid, the Emir of Seville offers to pay instead. Consequently, a joint Muslim-Castilian force builds the fortress of Belillos, from which the garrison raid into Granada.

• 1074 – Emir Al-Mutamid of Seville drives the Almoravids from Jaén.

• 1075 – Toledo takes Córdoba from Seville with the help of Castilian troops.

• 1076 – Emir Ahmad al-Muqtadir drives Slavs from Denia. Ferdinand I of León-Castile besieges Muslims and takes Coria in Badajoz. After the Emir of Toledo dies, Seville takes Córdoba back from his son al-Qadir.

• 1078 – Ibn Ammar acquires Murcia nominally on behalf of Seville but in reality as his own. Seville takes Valencia from Toledo. As a result, Al-Qadir of Toledo is forced from the city by a coup and his opponents acknowledge al-Mutawwakil of Badajoz as their new ruler. The Almoravids take Tangier. Ceuta hangs on as the last Zanata outpost because its fleet can supply it from sea.

• 1079 – Battle of Cabra. Rodrigo Díaz, defeats the Emir Abd Allah of Granada, who was helped by the Castilian Count García Ordíñez.

• Battle of Coria. Alfonso VI (already king of Castile and León) defeats the Muslim Emir of Badajoz, Al-Mutawwakil. Al-Mutawwakil renounces control of Toledo and al-Qadir is reinstated. A Leonese garrison is established at Zorita to the east of Toledo.

• 1080 – Ibn Ammar forced to flee Murcia.

• 1081 – El Cid, now a mercenary because he had been exiled by Alfonso IV of Castile, enters the service of the Moorish king of the northeast Spanish city of Zaragoza, al-Mu'tamin, and would remain there for his successor, al-Mu'tamin II.
• 1082 – Battle of Almenar. Rodrigo Díaz de Vivar, leading the army of Al-Mutamin of Zaragoza, defeats a combined army of the kings of Valencia (Al-Mundhir), Lleida (Al-Hayib), Aragon (Sancho Ramírez), and the Count of Barcelona (Berenguer Ramón II, who is captured). When Emir Al-Mutamid of Seville pays his tribute in debased coinage, Alfonso of León-Castile leads an expedition in Muslim territory.

• 1083 – In June–July Almoravids take Ceuta – the last outpost of the Zanata – and put to death the ruler, al-Muizz ibn Badis. Ships from Seville may have aided the attack. The same summer Alfonso of León-Castile reaches Tarifa overlooking the Straits of Gibraltar. Castile under Alfonso VI of León and Castile takes Madrid.

• 1084 – The Muslim army of Zaragoza under El Cid defeats the Aragonese. In autumn the Castilians start a loose siege of Toledo.

• 1085 – Christians take Salamanca.
  o Castile under Alfonso VI of León and Castile, Emperor of all Spains, takes Toledo.

• 1086 – Several Muslim Emirs (namely Abbad III al-Mu'tamid) ask the Almoravid leader Yusuf ibn Tashfín for help against Alfonso VI of León and Castile. In this year Yusuf ibn Tashfín passed the straits to Algeciras and inflicted a severe defeat on the Christians at the Battle of az-Zallaqah (North of Badajoz). He was debarred from following up his victory by trouble in North Africa which he had to settle in person.
  o Raymond of Burgundy, son of William I, Count of Burgundy, comes to Iberia for the 1st time to fight against the Moors, bringing with him his younger cousin Henry of Burgundy, grandson of Robert I, Duke of Burgundy.
  o In spring the Castilians besiege Zaragoza, but the siege is called off when the Almoravids land in the south. In June the Almoravids advance guard of 500 men take possession of Algeciras. The remaining 12–20,000 soon follow. Castilians under Alvar Fañez install al-Qadir as Emir of Valencia.
  o Almoravids, rampage through parts of Iberia, especially Granada and Lucena. There are persecutions and massacres. The wealthier Jews flee to Christian-held Iberia.
  o The Christian advance obliges the Muslim kings of Granada, Seville and Badajoz to call to their aid the Almoravids.
  o Battle of az-Zallaqah: At Sagrajas (Friday 23 October 1086) north-east of Badajoz, the Almoravids (12,000 or 20,000 men) under Yusuf ibn Tashfín and Andalusians (including Kings of Seville, Granada, Málaga, and Badajoz) defeat a predominantly Leonese-Castilian army (possibly 50-60,000 men including Jews, Aragonese, Italian and French) under Alfonso VI of León and Castile. The Andalusians encamp separately from the Almoravids. The Christian vanguard (Alvar Fañez) surprise the Andalusian camp before dawn; the men of Seville (Al-Mutamid) hold firm but the remaining Andalusians are chased off by the Aragonese cavalry. The Christian main body then attacks the Almoravids, but are held by the Lamtuma, and then withdraw to their own camp in
response to an outflanking move by ibn Tashufin. The Aragonese return to the field, do not like what they see, and start a withdraw which turns to a rout. The Andalusians rally, and the Muslims drive Alfonso to a small hill. Alfonso and 500 knights escape in the night to Toledo. Al-Mutamid proposes that the Christians are pursued and crushed, but Ibn Tashufin retires back to his African domains leaving only 3,000 troops to defend the east of Al-Andalus. Al-Mutamid and the Almoravid generals Sir ibn Abi Bakr and Dawud ibn Aisha are reported to have fought well during the battle.

- 1087 – Alfonso VI of León and Castile takes the fortress of Aledo in the territory of Murcia, blocking the route from Seville and Granada to the eastern provinces.
  - After his crushing defeat at Zallaqa, Alfonso VI of León and Castile swallows his pride and recalls El Cid from exile.

- 1088 – Yusuf ibn Tashfin arrives back in Algeciras (May–June) and is joined by al-Mutamid of Seville and Abd Allah of Granada, plus support from Almería and Murcia (but not the Emirs). The combined army besieges Aledo for 4 months, but Yusuf ibn Tashfin returns to Africa unsuccessful.

- 1090 – Yusuf ibn Tashfin returns to the Peninsula for the third time, takes over the kingdoms of Granada and Málaga in September and is back in Africa by the end of the year. However, this time his nephew Sir ibn Abi Bakr is left to continue the conquest. Between 30 April 1090 and 8 May 1090, Christian troops enter Santarém, Lisbon and Sintra. These were recently ceded by the Al-Mutawwakil of Badajoz in return for protection from the Almoravids.
  - Yusuf ibn Tashfin, King of the Almoravids, captures Granada.

- 1091 – The Almoravids led by Muhammad ibn al-Hajj take Córdoba and the Guadalquivir valley early in the year, and then defeat a Castilian force under Álvar Fáñez who were attempting to aid Al-Mutamid of Seville. In September Seville surrenders without much of a fight to Muhammad ibn Abi Bakr. Subsequently, other Almoravid armies take Aledo and Almería. Ronda also falls and the Almoravid commander Garur executes al-Radi (the son al-Mutamid of Seville).
  - Toledo falls to the Reconquista and will remain in Christian hands thereafter

- 1092 – With El Cid away in Zaragoza, the Valencians under the qadi Ibn Jahhaf and supported by a small Almoravid force, drive the Castilian garrison out and execute their Emir al-Qadir. Ibn Jahhaf promptly sets himself up at Emir and starts negotiating with both El Cid and the Almoravids.
  - Almoravid Sir ibn Abi Bakr takes Badajoz and Lisbon. Fall of the Taifa of Badajoz.
El Cid captures Valencia from the Moors, carving out his own kingdom along the Mediterranean that is only nominally subservient to Alfonso VI of León and Castile. Valencia would be both Christian and Muslim, with adherents of both religions serving in his army.

The Almoravids from Morocco land near Cuarte and lay siege to Valencia with 50,000 men. El Cid, however, breaks the siege and forces the Almoravids to flee – the first Christian victory against the hard-fighting Africans.

  - Almoravid (Muhammad ibn al-Hajj) defeat Castilians (Alfonso VI) at Consuegra. El Cid's son, Diego, is one of the dead.
  - Almoravid (Muhammad ibn Aisha) defeat Castilians (Alva Fañez) at Cuenca before ravaging the lands of Valencia.
  - Yusuf ibn Tashfin assumes the title of Amir al Muslimin (Prince of the Muslims).
- 1099 – The Almoravids besiege El Cid's Valencia, where he dies on 10 July 1099.
- 1100 – Molina falls to the Reconquista and will remain in Christian hands thereafter
- Beginning of 12th century – According to estimates, the Muslim population in Iberia may have reached 5.5 million, including Arabs, Berber and indigenous converts.
- 1102 – The followers of El Cid leave Valencia and the Muslims occupy the Peninsula as far as Zaragoza; Battle of Mollerussa near Lleida on 14 September.
  - Main Muslim mosque in Toledo converted to a church, Muslim population is sparse.
  - Christians evacuate Valencia in April–May. Almoravid (Mazdali, presumably ibn Tilankan; Muhammad ibn Fatima) occupy the city. Of the Taifa states only Zaragoza, Majorca, and Albarracin remain independent.
- 1103 – Ali, the brother of the Almoravid governor of Granada, Muhammad ibn al-Hajj, is killed in battle with the Castilians near Talavera.
- 1105 – The Almohads, founded by Ibn Tumart, began as a religious movement to rid Islam of impurities. Most specifically, the Almohads were opposed to anthropomorphisms which had slipped into Iberian Islam. Ibn Tumart's successor, Abd al-Mu'min, turned the movement against non-Muslims, specifically Jews and Christians. Sweeping across North Africa and into Muslim Iberia, the zealous Almohads initiate riots and persecutions of both Muslims and non-Muslims. In some towns Jews and Christians are given the choice of conversion, exile, or death.
- 1106 – Yusuf ibn Tashfin dies and his son, Ali, takes over the Almoravid empire.
- 1108 – The Almoravids under Tamim ibn Yusuf ibn Tashfin, the brother of the ruler; another general is Muhammad ibn Fatima, the grandson of Sir ibn Abi Bakr, take the small town of Uclés to the east of
Toledo, but a ridge top fortress holds out. Alfonso VI of León and Castile sends a relieving army under Alvar Fañez. The Almoravids decisively beat the Castilians and many leaders are killed, including Sancho, Alfonso’s only son (by Zaida, a Muslim princess) and heir. Subsequently, the Almoravids pretend to withdraw then launch a successful surprise attack on the castle. As a result, the Christians abandon Cuenca and Huete.

- Almoravid (Tamim ibn Yusuf ibn Tashfin) storm Talavera on the Tagus to the west of Toledo. The country to the north and south of Toledo is ravaged and the city unsuccessfully besieged for a month. Alvar Fañez leads the defence. Emir Ali ibn Yusuf ibn Tashfin joined this year’s Jihad but does not mention him in the actions.

- 1110 – Al-Mustain of Zaragoza leads an expedition against the Christians, but is killed at Valtierra. His son, Imad al-Din, fails to establish his rule and the Almoravid (ibn al-Hajj) marches in (30 May 1110).

- 1111 – Almoravids led by Sir ibn Abi Bakr occupy Lisbon and Santarém in the west. These cities were occupied by the Almoravids in 1094-95 this suggests a fluctuating border in Portugal.

- 1112 – By this time the Aragonese have taken Huesca. Almoravid (ibn al-Hajj) raids into Aragonese territory and reaches the foothills of the Pyrenees.

- 1114 – A major Almoravid expedition (ibn al-Hajj from Zaragoza and Ibn Aisha of Valencia) raids into Catalonia. The army ravages Christian territory but is ambushed on its return and both Almoravid generals are killed. The Catalans under Count Ramon Berengar III take over the Balearic Islands upon the death of Emir Mubashir ibn Sulayman of Majorca.

- 1115 – The new Almoravid governor of Zaragoza, Abu Bakr ibn Ibrahim ibn Tifilwit, lays siege to Barcelona for 20 days. The Almoravids withdraw when Count Ramon Berengar III returns from Majorca. The Almoravid fleet takes the Balearic Islands. The Almoravid general and governor of Granada Mazdali ibn Tilankan dies in battle this year. He led expeditions against the Christians from 1111, so he might have led an expedition separate from those of Abu Bakr and the fleet. His son, Muhammad, governor of Córdoba, also dies in battle this year (against the Castilians), so it may have been the same expedition.

- 1117 – Almoravids under Emir Ali ibn Yusuf himself take Coimbra, but abandon the city after a few days.

- 1118 – Alfonso I of Aragon takes Saragossa from the Muslims. Settlers in the reconquered no-man’s lands of Castile are granted fueros, special rights.

The Aragonese led Alfonso–I the Battler seize Zaragoza and most of the central lands of the Ebro. The siege of Zaragoza lasts from 22 May 1118 to 18 December 1118. The garrison has 20 mangonels and is supported by a determined militia. As a result of a plea for help of 3 December...
the Almoravid governor of Valencia sends a relief force, but this is too small to help. Lleida only remains in Muslim hands because it is tributary to Barcelona.

- Zaragoza falls to the Reconquista and will remain in Christian hands thereafter

- 1120 – Alfonso I of Aragon decisively defeats an Almoravid army including many Andalusian volunteers at Cutanda in summer.

- 1121 – The Aragonese take Calatayud. The Córdobans rebel against the Almoravids, and drive the governor and his troops from the city. The Emir Ali ibn Yusuf ibn Tashfin leads an army from Africa to suppress the rebellion. The Almoravids besiege the city, and persuade the Córdobans to lay down their arms.

- 1122 – Aragonese take Daroca.

- 1125 – In September, Alfonso I of Aragon sets out south with an army of 4,000 knights. He travels down the east coast, bypasses the cities and ravages the countryside. He reaches Guadix unopposed in December.

- 1126 – The Almoravids deport Christians to Morocco.
  - Alfonso I of Aragon defeats the Almoravids at Arinzul near Lucena. After symbolically fishing at Motril on the south coast, Alfonso returns home undefeated.

- 1129 – Alfonso I of Aragon defeats an Almoravid army led by Ali ibn Majuz, the governor of Seville deep inside Valencian territory. This is probably at Cullera or Alcalá near Alzira.

Decline and submission to Christian rule (1130–1481)

- 1130 – Tashfin ibn Ali ibn Yusuf (the son of the Almoravid Emir) takes the castle of Aceca south of Toledo. The Almoravid (Governor of Valencia) defeat invading Aragonese and kill Gaston IV of Béarn of the First Crusade.


- 1134 – Almoravid (Tashfin ibn Ali ibn Yusuf) raids in the Caceres area.
  - Aragonese Alfonso I of Aragon besiege the small town of Fraga. An Almoravid relief army (Yahya ibn Ali ibn Ghaniya) defeats the overconfident Aragonese, and a sally of the garrison destroys the besiegers' camp. Alfonso I of Aragon is ambushed while raiding Lleida and is severely wounded and dies soon after.

- 1135 – Birth of Rabbi Moses Ben Maimon (called "Rambam" or Moses Maimonides).

- 1136 – Almoravid (Yahya ibn Ali ibn Ghaniya; Sa'd ibn Mardanish) retakes Mequinenza on the lower Ebro.
- 1137 – Almoravid (Tashfin ibn Ali ibn Yusuf) defeat the Castilians near Alcázar de San Juan and sack the castle at Escaloná north of the Tagus.
  - Prince Afonso I of Portugal tries and fails to take Lisbon from the Moors.
- 1140 – Poema del Mio Cid written.
  - King Afonso I of Portugal tries and fails to take Lisbon from the Moors.
  - The Taifa of Mértola and of Silves again become independent.
- 1145 – The Córdobans evict the Almoravid governor at the beginning of the year and raise up Hamdin ibn Huwaydim ibn Hamdín as Emir. A Zaragozan adventurer in Castilian employ (Sayf al-Dawla ibn Hud al-Mustansir) briefly seizes power from ibn Hamdin in March but flees to the Levante due to popular hostility. Ibn Hamdin returns to power but is soon dispossessed by the Almoravid (Yahya ibn Ali ibn Ghaniya). In March the Andalusian Jund in Valencia raise up the qadi Marwan ibn Abd al-Aziz as Emir. When he cannot pay them they replace him with their own leader Ibn Iyad.
  - Portugal retakes Leiria from the Moors.
  - The Taifa of Badajoz again becomes independent and takes the Taifa of Mértola.
  - The Taifa of Mértola gains independence from Badajoz.
- 1147 – Alfonso VII of Castile takes Calatrava.
  - March – King Afonso I of Portugal takes the Taifa of Santarém in a surprise attack.
  - Santarém falls to the Reconquista and will remain in Christian hands thereafter
  - An international Christian coalition attacks Almería by land and sea. Alfonso VII of Castile and Sancho Ramirez of Navarre march overland taking Andújar and Baeza en route. Ramon Berengar IV of Aragon-Catalonia and a Genoese naval contingent join them at Almería. There is no opposition from the Almoravid fleet. Almería falls on 17 Oct and is given to the Genoese.
A Crusaders' fleet arrives at the Portuguese city of Porto, and are convinced to join King Afonso I of Portugal in the Siege of Lisbon, which falls after several months. Some Muslims are killed, and the city was thoroughly plundered by the Crusaders.

- Lisbon falls to the Reconquista and will remain in Christian hands thereafter
- The towns of Almada and Palmela, just south of Lisbon, are taken from the Moors by the Portuguese.

- 1148 – Almohads take Seville. Aragonese take Tortosa.
- 1149 – Aragonese take Lleida and Fraga.
- 1150 – The Taifas of Badajoz and of Beja and Évora are taken by the Almohads.
- 1151 – The Almohads, another more conservative African Muslim dynasty who have displaced the Almoravids, retake Almería. Jews and Mozárabes (Christians in Muslim lands) flee to the northern Christian kingdoms of Spain, or to Africa and the East, including Rambam.
- 1155 – Almohads take Granada from Almoravids.
- 1157 – Almohads take Almeria from Genoese.
- 1158 – King Afonso I of Portugal takes Alcácer do Sal from the Moors.
- 1159 – Évora and Beja, in the southern province of Alentejo, are taken from the Moors by the Portuguese.
- 1160 – Maimonides and his family took refuge in Fez in Morocco, which had been spared by the Almohads.
- 1161 – Évora, Beja and Alcácer do Sal are retaken by the Moors.
- 1162 – King Afonso I of Portugal retakes Beja from the Moors.
- 1163 – The Almohad Caliph Abd al-Mu'min al-Kumi dies and is succeeded by Abu Ya'qub Yusuf I.
- 1165 – Faked conversions become widespread with the accession of the sultan Abu Yakub. His son, Yakub Al-Mansur (1184–1199) imposes several restrictions upon the new converts. They could marry only among themselves and were forbidden to engage in large-scale trading. Doubting the sincerity of their conversion, in 1198, he also ordered them to wear a special degrading garb: a blue tunic one cubit long with ridiculously long wide sleeves. The converts were compelled to wear a blue skullcap which fell below their ears in the shape of a donkey's packsaddle, instead of the usual turbans.
- 1165 – Maimonides and his family leave Fez.
The Portuguese armies, led by Geraldo the Fearless, retake Évora from the Moors.

- 1166 – The Portuguese armies take Serpa and Moura (in Alentejo) from the Moors.
- 1168 – Portuguese frontiersman Geraldo the Fearless goes into the territory of Badajoz.
- 1169 – King Afonso I of Portugal grants the Knights Templar one third of all they take from the Moors in Alentejo.
  - Geraldo the Fearless seizes Badajoz from the Almohads.
  - King Afonso I of Portugal is wounded by a fall from his horse in Badajoz, and is captured by the competing forces of King Ferdinand II of León. As ransom King Afonso I was obliged to surrender almost all the conquests he had made in Galicia in the previous years, as well as Badajoz, that the Leonese gave back to the Almohads as a vassal territory.
- 1170 – The Almohads transfer their capital to Seville.
- 1171 – Almohad Muslims begin building the Alcázar, their palace.
- 1172 – Almohads capture Murcia. Almohads take over Valencia when ibn Mardanish dies.
- 1179 – Castile and Aragon agree on future partition of Al-Andalus.
- 1184 – The Portuguese defeat the Almohads at Santarém.
  - Yusuf I, Almohad Caliph, dies and is succeeded by Abu Yusuf Ya'qub al-Mansur.
- 1190 – Maimonides writes the *Moreh Nebukhim*, or *Guide to the Perplexed*, using rationalism to reconcile Judaism with Aristotle's laws of nature, and *Shloshah-Asar Ikkarim*, the *Thirteen Articles of Faith*.
- 1195 – The Almohads defeat the Castilians at Alarcos.
- 1199 – The Almohad Caliph Abu Yusuf Ya'qub al-Mansur dies and is succeeded by Muhammad an-Nasir.
- 1200 – Ibn Tumart's successor, Abd al-Mumin, turned the movement against non-Muslims, specifically Jews and Christians. Sweeping across North Africa and into Muslim Iberia, the zealous Almohads initiated riots and persecutions of Muslims and non-Muslims. In some towns Jews and Christians were given the choice of conversion, exile, or death.
- 1203 – The Almohads take Majorca from the Almoravid.
- 1205 – Death of Maimonides in Egypt.
- 1212 – Battle of Las Navas de Tolosa: Alfonso VIII of Castile, Sancho VII of Navarre, Pedro II of Aragon and Afonso II of Portugal, defeat Almohad (Caliph Muhammad an-Nasir) at the Battle of Las Navas de Tolosa. The Christians had 60-100,000 infantry and 10,000 cavalry, and had troops from Western Europe, Castile, Navarre, Aragon, León and Portugal, Military Orders (Knights Templar, Knights Hospitaller, Santiago, Cavatrava), and urban militias.
  - After the defeat the Almohad empire goes into a serious decline in Spain and in North Africa.
- 1213 – Abu Ya'qub Yusuf II becomes Almohad Caliph.
- 1217 – The Portuguese take the town of Alcácer do Sal from the Moors.
- 1217–1252 – Fernando III, king of Castile and León, conquers Córdoba, Murcia, Jaén, and Seville. Granada remains as the sole independent Muslim kingdom.
- 1227 – Denia falls to the Reconquista and will remain in Christian hands thereafter.
  - The Muslim governor of Murcia, Ibn Hud, becomes the leader of rebellions against the Almohad rulers.
- 1228 – Badajoz falls to the Reconquista and will remain in Christian hands thereafter.
  - Ibn Hud establishes himself emir of Murcia.
- 1229 – James I of Aragon, the Conqueror, retakes Majorca, Jerica and Murviedad-Sagunto which will remain in Christian hands thereafter.
- 1230 – Alfonso IX of Leon advances along the River Guadiana, takes Mérida and Badajoz, and opens up the way for the conquest of Seville.
- 1230 – Castilian forces under Ferdinand III of Castile fail in an attempt to conquer the city of Jaén from the Taifa of Jayyân when the Castilian forces withdrew upon hearing news of the death of Alfonso IX of León.
- 1232 – Ibiza falls to the Reconquista and will remain in Christian hands thereafter.
  - Mohammed ibn Alhamar proclaims himself sultan of Arjona and founds the Nasrid dynasty.
- 1233 – Castile defeats Granada at the Battle of Jerez.
- 1236 – Portugal captures most of the Algarve.
  - Castile forces under Ferdinand III of Castile recapture Córdoba which will remain in Christian hands thereafter. Ibn Hud is forced to sign a truce.
  - Castilian forces include urban militia.
  - The Nasrid ruler, Mohammed ibn Alhamar, approaches Ferdinand III of Castile to propose that in return for cooperating in the conquest of Muslim Seville, Granada would be granted independence as a subject of Castile. Fernando agrees and takes Seville.
- 1237 – Mohammed ibn Alhamar enters Granada, soon to become the new capital of his dominion. On returning to Granada, the embarrassed ibn-Alhamar announces "there is no victor but Allah", which was to become the motto of the Nasrid dynasty and to be inscribed all over the Alhambra palace.
- 1238 – Aragon captures Valencia. Aragonese forces include urban militia.
  - The Emirate of Granada is officially founded.
  - James I retakes Valencia, Albarracin, Alpuente, Tortosa from the Muslims, all of which would remain in Christian hands thereafter. He also gains control of the prized paper manufacturing centre at Xàtiva.
1243 – James I retakes Murcia from the Moors and it will remain in Christian control thereafter.

1244 – Arjona and Baeza fall to the Reconquista and will remain in Christian hands thereafter.
  - James I of Aragon captures the Xativa Castle and city from Abu Bakr who signs the Treaty of Xàtiva effectively becoming a vassal to the Christian Kingdom.

1245 – Muslim troubles start in Valencia.
  - Muslim commander Al-Azraq surrenders to James I of Aragon and signs the Al-Azraq Treaty of 1245. Cartagena was captured by Aragon and will remain in Christian control thereafter.

1246 – Carmona falls to the Reconquista and will remain in Christian hands thereafter.
  - Jaén is handed over by Mohammed ibn Alhamar to Ferdinand III of Castile. They sign the Treaty of Jaén, which establishes the Emirate of Granada as vassal state of Castile.

1247 – Having had time to secretly regroup his forces Al-Azraq breaks the treaty that he had signed in 1245 and leads a revolt in Valencia.
  - The Muslim rebels in Valencia retreat into the territory controlled by the Mudéjar lord Al-Azraq who holds 8 castles in the Alcalá valley. They seize more castles and continue a successful guerrilla war.

1248 – Christian armies under Ferdinand III of Castile take Seville after 16 months of siege, despite Muslim catapults, Greek fire, and bowmen who pierce armor. Castilian forces include urban militia.
  - 4 December, Alfonso X the Wise reconquest Alicante to Castile.

1249 – King Afonso III of Portugal takes Faro (in the Algarve) from the Moors, thus removing the last Muslim state from Portuguese soil and ending the Portuguese Reconquista.
  - The Muslims fend off a major Christian offensive under King James I of Aragon.
  - Orihuela falls to the Reconquista and will remain in Christian hands thereafter.

1250 – Tejada, Constantina, Huelva and Jerez fall to the Reconquista and will remain in Christian hands thereafter.

1252–1284 – Alfonso X the Wise continues the Christian reconquest of the peninsula and is obliged to face the Mudéjar revolts of Andalusia and Murcia. He seeks election as emperor of the Holy Roman Empire in 1257. He drafts the Fuero de las Leyes, the forerunner of the Siete Partidas.

1256 – Fighting flares up between the Valencia rebels and the Aragonese.

1257 – Muslims use some form of incendiary weapon at Niebla.

1258 – King James I of Aragon takes al-Azraq’s main citadel and suppresses the Valencian rebellion.

1262 – Niebla and Cádiz falls to the Reconquista and will remain in Christian hands thereafter.

1264 – Muslim revolt in Andalusia.

1266 – Lorca, Murcia, Purchena and Segura are retaken from the Muslims and will remain in Christian hands thereafter.
1275 – Four Marinid expeditions to Iberia.
  o Muslims defeat Christians at the Battle of Ecija.
1276 – Muslim revolt in Valencia.
1280 – Muslim Granadian forces under the command of Muhammad II defeat invading Christian forces under the command of Gonzalo Ruiz Girón at the Battle of Moclín.
1280 – Muslims use some form of incendiary weapon at Córdoba.
1287 – Menorca falls to the Reconquista and will remain in Christian hands thereafter.
1292 – Castile captures Tarifa from Marinids.
1306 – Muslims use some form of incendiary weapon at Gibraltar.
1309 – Ferdinand IV of Castile takes Gibraltar.
  o Algeciras falls to the Reconquista and will remain in Christian hands thereafter.
1310 – Castile captures Gibraltar.
1312–1350 – War between Alfonso XI and Granada:-
  1319 – Granada defeats Castilian invasion.
1324 – Catalonia occupies Sardinia.
1325 – Alfonso XI decides to avenge the defeat against his army in 1319. His armies re-attack Granada. This time, they are victorious and manage to defeat Muhammad IV.
1331 – Granada uses iron balls propelled by fire or containing fire against Alicante and Orihuela.
1333 – Granada retakes Gibraltar from the Castilians.
1340 – The combined armies of King Afonso IV of Portugal and King Alfonso XI of Castille defeat a Muslim army at the Battle of Rio Salado.
1343 – Granada uses cannons in the (unsuccessful) defence of Algeciras.
1394 – Battle of Egea. Granadine troops become the first troops in Iberia to use handguns.
1410 – An attack against Granada is led by Ferdinand, regent of Castile and future king of Aragon. He does not take Granada, but he takes the city of Antequera. This is considered the most important victory against the Muslims since the reign of Alfonso XI.
1415 – Portugal takes the city of Ceuta in North Africa.
1462 – Castile takes Gibraltar again.
Castile-Aragón conquers the emirate of Granada (1481–1491)

- 26 December 1481 – The Granadines (Emir Abu l-Hasan Ali) surprise the Castilian garrison of Zahara on a stormy night. The population is enslaved.
- 1482 – Forces of Castile–Aragon (2500 cavalry and 3000 infantry) under Rodrigo Ponce de León, Marquis of Cadiz gather at Marchena (25 Feb), march to Antequera, cross the Sierra Alzerifa, and then seize Granadine Alhama on a stormy night before dawn (28 February 1482). Abu l-Hasan attempts to retake Alhama by siege (5–19 March) but withdraws unsuccessfully to Granada. Muslim troops from Ronda raid the Arcos area to try to tempt the Marquis out of Alhama. In support of his men at Alhama, King Ferdinand marches to Lucena, sends reinforcements to Alhama (30 April 1482), withdraws to Córdoba to organise a major force, and then formally takes over Alhama (14 May 1482).
- 1483 – Battle of Axarquía. A fast moving Castilian force raids into the mountains of Axarquía. Emir Muhammad XII of Granada becomes the first King of Granada to be captured by the Christians.
- 1484 – The Castilian-Aragonese army led by King Ferdinand II of Aragon assembles at Antequera in Spring, marches to Álora, raids Coin, Cazabonela, Almjia, Córtama, Pupiana, Alhendrin, and the fertile valley of Málaga before returning to Antequera. They capture Álora and Senetil and raid into the fertile valley of Granada.
- 1485 – Al-Zagal drives Muhammad XII from Almería. Muhammad XII flees to King Ferdinand II of Aragon, at Córdoba. Ferdinand besieges Coin and Córtama. Al-Zagal then attempts to relieve the sieges, but first Coin falls (27 April 1485) then Córtama (28 April 1485). The garrison of Ronda raids Medina Sidonia but returns to find its city besieged by Ferdinand in early May. Abu Hasan of Granada dies and Al-Zagal assumes title of Emir in late May; Al-Zagal defeats a Christian foraging party from Alhama on his way to Granada. Three groups of Castilian–Aragonese march toward Moclin (late Aug). Al-Zagal ambushes and defeats the first group, although it is rescued by the second group of Christians in early September. Al-Zagal enters Moclin. The third Castilian-Aragonese group (Ferdinand) joins the other two and they take the castles of Cambil and Albahar (23 September 1485). The Castilian-Aragonese of Alhama also take the castle of Zalea in September.
- 1487 – Málaga falls to the Reconquista after the Siege of Málaga (1487).
- 1489 – Spain captures Baza. Al-Zagal surrenders to Spain.
  - Almeria falls to the Reconquista.
- 1491 – Granada surrenders to the Castilian-Aragonese forces. Abu 'abd Allah Muhammad XII, Emir of Granada, relinquishes the last Muslim-controlled city in the Iberian Peninsula to the expanding Crown of Castile, and signs the Treaty of Granada.

**Aftermath (1492–1614)**

- 2 January 1492 – The Catholic Monarchs, Queen Isabella I of Castile and King Ferdinand II of Aragon, take over Granada.
- 1492–1507 – The remaining Muslims in the Crown of Castile were ordered to become Catholic. King Ferdinand ordered to convert mosques to Christian churches. The king then appeals to the reigning Pope Julius II (nephew of Sixtus IV) to grant the aspirations of these new Christians. This new Christian population, forcibly converted, will come to be known as the Moriscos. Jews who were forcibly converted are known as marranos. Hundreds of thousands of Jews who did not accept conversion were expelled from Spain. They fled with nothing more than the clothes on their backs for the Ottoman Empire, Italy, Egypt and other areas.
- 1496 – All Muslims (and Jews) in Portugal were expelled from Portugal.
- 1499-1501 – A Muslim rebellion in Granada, following forced conversion of Muslims, contrary to terms of surrender; The rebellion was defeated in 1501.
- 1501-1502 All Muslims in the Crown of Castile (including the former Emirate of Granada) were forced to convert to Christianity.
- 1504 – The Oran fatwa was issued, following the forced conversion of 1501-1502, providing the basis of the secret practice of Islam in Spain.
- 1516 – King Charles I, the grandson of Ferdinand and Isabella, rises to the throne of both Castile and Aragon. With the conquest of Granada and Iberian Navarre, the modern state of Spain is formed. Muslims in the kingdom of Navarre are forced to convert,
- 1519–1522 – Revolt of the Brotherhoods in the Kingdom of Valencia. A middle-class rebellion simultaneously targeting the noble landed class and Muslim peasantry, resulting in the killing and forced conversions of many of the latter, known as Mudéjars.
- 1525 – Muslims in the Crown of Aragon are forced to convert to Christianity as a concession to the old-Christian guilds or Germanias which had revolted a few years earlier.
- 1526 – After convening a council to examine the problem, King Charles I declares that the forced conversions of the Muslims of Valencia and Aragon were valid, because they could have chosen death rather than convert.
- 1568 – Rebellion of the Alpujarras. After King Philip II introduces laws prohibiting Moorish culture, the people who had forcefully converted to Christianity in order to remain in Spain, then known as Moriscos,
revolt under the leadership of Aben Humeya in Granada. The rebellion is suppressed in 1571 by John of Austria, Philip II's half-brother, and rebels are deported to different parts of the northern half of the Iberian peninsula.

- 1570 – Around 80,000 Moriscos are deported from the Kingdom of Granada resettled in towns and villages throughout Andalusia and Castile.
- 1609 – Expulsion of the Moriscos – King Philip III issues the Act of Expulsion for all remaining Moriscos, claiming that they appealed to the Ottoman Empire for military intervention in Spain. They are viewed by some as a fifth column trying to rebuild the Muslim state in the Peninsula.
- 1614 – The process of expulsion ends.

### Timeline of category theory and related mathematics

**Timeline to 1945: before the definitions**

<table>
<thead>
<tr>
<th>Year</th>
<th>Contributors</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1890</td>
<td>David Hilbert</td>
<td>Resolution of modules and free resolution of modules.</td>
</tr>
<tr>
<td>1890</td>
<td>David Hilbert</td>
<td>Hilbert's syzygy theorem is a prototype for a concept of dimension in homological algebra.</td>
</tr>
<tr>
<td>1893</td>
<td>David Hilbert</td>
<td>A fundamental theorem in algebraic geometry, the Hilbert Nullstellensatz. It was later reformulated to: the category of affine varieties over a field $k$ is equivalent to the dual of the category of reduced finitely generated (commutative) $k$-algebras.</td>
</tr>
<tr>
<td>1894</td>
<td>Henri Poincaré</td>
<td>Fundamental group of a topological space.</td>
</tr>
<tr>
<td>1895</td>
<td>Henri Poincaré</td>
<td>Simplicial homology.</td>
</tr>
<tr>
<td>1895</td>
<td>Henri Poincaré</td>
<td>Fundamental work <em>Analysis situs</em>, the beginning of algebraic topology.</td>
</tr>
<tr>
<td>c.1910</td>
<td>L. E. J. Brouwer</td>
<td>Brouwer develops intuitionism as a contribution to foundational debate in the period roughly 1910 to 1930 on mathematics, with intuitionistic logic a by-product of an increasingly sterile discussion on formalism.</td>
</tr>
<tr>
<td>1923</td>
<td>Hermann Künneth</td>
<td>Künneth formula for homology of product of spaces.</td>
</tr>
<tr>
<td>1926</td>
<td>Heinrich Brandt</td>
<td>defines the notion of groupoid</td>
</tr>
<tr>
<td>1928</td>
<td>Arend Heyting</td>
<td>Brouwer's intuitionistic logic made into formal mathematics, as logic in which the Heyting algebra replaces the Boolean algebra.</td>
</tr>
<tr>
<td>1929</td>
<td>Walther Mayer</td>
<td>Chain complexes.</td>
</tr>
<tr>
<td>1930</td>
<td>Ernst Zermelo--</td>
<td>Statement of the definitive ZF-axioms of set theory, first stated in 1908 and</td>
</tr>
<tr>
<td>Year</td>
<td>Mathematician(s)</td>
<td>Contribution</td>
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</tr>
<tr>
<td>c.1930</td>
<td>Emmy Noether</td>
<td>Module theory is developed by Noether and her students, and algebraic topology starts to be properly founded in abstract algebra rather than by <em>ad hoc</em> arguments.</td>
</tr>
<tr>
<td>1932</td>
<td>Eduard Čech</td>
<td>Čech cohomology, homotopy groups of a topological space.</td>
</tr>
<tr>
<td>1933</td>
<td>Solomon Lefschetz</td>
<td>Singular homology of topological spaces.</td>
</tr>
<tr>
<td>1934</td>
<td>Reinhold Baer</td>
<td>Ext groups, Ext functor (for abelian groups and with different notation).</td>
</tr>
<tr>
<td>1935</td>
<td>Witold Hurewicz</td>
<td>Higher homotopy groups of a topological space.</td>
</tr>
<tr>
<td>1937</td>
<td>Richard Brauer–Cecil Nesbitt</td>
<td>Frobenius algebras.</td>
</tr>
<tr>
<td>1938</td>
<td>Hassler Whitney</td>
<td>&quot;Modern&quot; definition of cohomology, summarizing the work since James Alexander and Andrey Kolmogorov first defined cochains.</td>
</tr>
<tr>
<td>1940</td>
<td>Kurt Gödel–Paul Bernays</td>
<td>Proper classes in set theory.</td>
</tr>
<tr>
<td>1943</td>
<td>Samuel Eilenberg–Saunders Mac Lane</td>
<td>Universal coefficient theorem for Čech cohomology; later this became the general universal coefficient theorem. The notations Hom and Ext first appear in their paper.</td>
</tr>
<tr>
<td>1943</td>
<td>Norman Steenrod</td>
<td>Homology with local coefficients.</td>
</tr>
<tr>
<td>1943</td>
<td>Israel Gelfand–Mark Naimark</td>
<td>Gelfand–Naimark theorem (sometimes called Gelfand isomorphism theorem): The category Haus of locally compact Hausdorff spaces with continuous proper maps as morphisms is equivalent to the category C<em>Alg of commutative C</em>-algebras with proper *-homomorphisms as morphisms.</td>
</tr>
<tr>
<td>1944</td>
<td>Garrett Birkhoff–Øystein Ore</td>
<td>Galois connections generalizing the Galois correspondence: a pair of adjoint functors between two categories that arise from partially ordered sets (in modern formulation).</td>
</tr>
<tr>
<td>1944</td>
<td>Samuel Eilenberg</td>
<td>&quot;Modern&quot; definition of singular homology and singular cohomology.</td>
</tr>
<tr>
<td>1945</td>
<td>Beno Eckmann</td>
<td>Defines the cohomology ring building on Heinz Hopf's work.</td>
</tr>
<tr>
<td>Year</td>
<td>Contributors</td>
<td>Event</td>
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</tr>
<tr>
<td>1945</td>
<td>Saunders Mac Lane–Samuel Eilenberg</td>
<td>Start of category theory: axioms for categories, functors and natural transformations.</td>
</tr>
<tr>
<td>1945</td>
<td>Norman Steenrod–Samuel Eilenberg</td>
<td>Eilenberg–Steenrod axioms for homology and cohomology.</td>
</tr>
<tr>
<td>1945</td>
<td>Jean Leray</td>
<td>Starts sheaf theory: At this time a sheaf was a map that assigned a module or a ring to a closed subspace of a topological space. The first example was the sheaf assigning to a closed subspace its p-th cohomology group.</td>
</tr>
<tr>
<td>1945</td>
<td>Jean Leray</td>
<td>Defines sheaf cohomology using his new concept of sheaf.</td>
</tr>
<tr>
<td>1946</td>
<td>Jean Leray</td>
<td>Invents spectral sequences as a method for iteratively approximating cohomology groups by previous approximate cohomology groups. In the limiting case it gives the sought cohomology groups.</td>
</tr>
<tr>
<td>1948</td>
<td>Cartan seminar</td>
<td>Writes up sheaf theory for the first time.</td>
</tr>
<tr>
<td>1948</td>
<td>A. L. Blakers</td>
<td>Crossed complexes (called group systems by Blakers), after a suggestion of Samuel Eilenberg: A nonabelian generalization of chain complexes of abelian groups which are equivalent to strict ∞-groupoids. They form a category Crs that has many satisfactory properties such as a monoidal structure.</td>
</tr>
<tr>
<td>1949</td>
<td>André Weil</td>
<td>Formulates the Weil conjectures on remarkable relations between the cohomological structure of algebraic varieties over $\mathbb{C}$ and the diophantine structure of algebraic varieties over finite fields.</td>
</tr>
<tr>
<td>1950</td>
<td>Henri Cartan</td>
<td>In the book Sheaf theory from the Cartan seminar he defines: Sheaf space (étale space), support of sheaves axiomatically, sheaf cohomology with support in an axiomatic form and more.</td>
</tr>
<tr>
<td>1950</td>
<td>John Henry Whitehead</td>
<td>Outlines algebraic homotopy program for describing, understanding and calculating homotopy types of spaces and homotopy classes of mappings.</td>
</tr>
<tr>
<td>1950</td>
<td>Samuel Eilenberg–Joe Zilber</td>
<td>Simplicial sets as a purely algebraic model of well behaved topological spaces. A simplicial set can also be seen as a presheaf on the simplex category. A category is a simplicial set such that the Segal maps are isomorphisms.</td>
</tr>
<tr>
<td>1951</td>
<td>Henri Cartan</td>
<td>Modern definition of sheaf theory in which a sheaf is defined using open subsets instead of closed subsets of a topological space and all the open subsets are treated at once. A sheaf on a topological space $X$ becomes a functor resembling a function defined locally.</td>
</tr>
</tbody>
</table>
on X, and taking values in sets, abelian groups, commutative rings, modules or generally in any category C. In fact Alexander Grothendieck later made a dictionary between sheaves and functions. Another interpretation of sheaves is as continuously varying sets (a generalization of abstract sets). Its purpose is to provide a unified approach to connect local and global properties of topological spaces and to classify the obstructions for passing from local objects to global objects on a topological space by pasting together the local pieces. The C-valued sheaves on a topological space and their homomorphisms form a category.

<table>
<thead>
<tr>
<th>Year</th>
<th>Person/Event</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td>William Massey</td>
<td>Invents exact couples for calculating spectral sequences.</td>
</tr>
<tr>
<td>1953</td>
<td>Jean-Pierre Serre</td>
<td>Serre C-theory and Serre subcategories.</td>
</tr>
<tr>
<td>1955</td>
<td>Jean-Pierre Serre</td>
<td>Shows there is a 1-1 correspondence between algebraic vector bundles over an affine variety and finitely generated projective modules over its coordinate ring.</td>
</tr>
<tr>
<td>1955</td>
<td>Jean-Pierre Serre</td>
<td>Coherent sheaf cohomology in algebraic geometry.</td>
</tr>
<tr>
<td>1956</td>
<td>Jean-Pierre Serre</td>
<td>GAGA correspondence.</td>
</tr>
<tr>
<td>1956</td>
<td>Henri Cartan–Samuel Eilenberg</td>
<td>Influential book: <em>Homological Algebra</em>, summarizing the state of the art in its topic at that time. The notation $\text{Tor}_n$ and $\text{Ext}^n$, as well as the concepts of projective module, projective and injective resolution of a module, derived functor and hyperhomology appear in this book for the first time.</td>
</tr>
<tr>
<td>1956</td>
<td>Daniel Kan</td>
<td>Simplicial homotopy theory also called categorical homotopy theory: A homotopy theory completely internal to the category of simplicial sets.</td>
</tr>
<tr>
<td>1957</td>
<td>Alexander Grothendieck</td>
<td>Abelian categories in homological algebra that combine exactness and linearity.</td>
</tr>
<tr>
<td>1957</td>
<td>Alexander Grothendieck</td>
<td>Influential <em>Tohoku</em> paper rewrites homological algebra; proving Grothendieck duality (Serre duality for possibly singular algebraic varieties). He also showed that the conceptual basis for homological algebra over a ring also holds for linear objects varying as sheaves over a space.</td>
</tr>
<tr>
<td>1957</td>
<td>Alexander Grothendieck</td>
<td>Grothendieck's relative point of view, S-schemes.</td>
</tr>
<tr>
<td>1957</td>
<td>Daniel Kan</td>
<td>Kan complexes: Simplicial sets (in which every horn has a filler) that are geometric models of simplicial $\infty$-groupoids. Kan complexes are also the fibrant (and cofibrant) objects of model categories of simplicial sets for which the fibrations are Kan fibrations.</td>
</tr>
<tr>
<td>Year</td>
<td>Name</td>
<td>Contribution</td>
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<tr>
<td>------</td>
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<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1958</td>
<td>Alexander Grothendieck</td>
<td>Starts new foundation of algebraic geometry by generalizing varieties and other spaces in algebraic geometry to scheme which have the structure of a category with open subsets as objects and restrictions as morphisms. form a category that is a Grothendieck topos, and to a scheme and even a stack one may associate a Zariski topos, an étale topos, a fppf topos, a fpqc topos, a Nisnevich topos, a flat topos, ... depending on the topology imposed on the scheme. The whole of algebraic geometry was categorized with time.</td>
</tr>
<tr>
<td>1958</td>
<td>Roger Godement</td>
<td>Monads in category theory (then called standard constructions and triples). Monads generalize classical notions from universal algebra and can in this sense be thought of as an algebraic theory over a category: the theory of the category of T-algebras. An algebra for a monad subsumes and generalizes the notion of a model for an algebraic theory.</td>
</tr>
<tr>
<td>1958</td>
<td>Daniel Kan</td>
<td>Adjoint functors.</td>
</tr>
<tr>
<td>1958</td>
<td>Daniel Kan</td>
<td>Limits in category theory.</td>
</tr>
<tr>
<td>1958</td>
<td>Alexander Grothendieck</td>
<td>Fibred categories.</td>
</tr>
<tr>
<td>1959</td>
<td>Bernard Dwork</td>
<td>Proves the rationality part of the Weil conjectures (the first conjecture).</td>
</tr>
<tr>
<td>1959</td>
<td>Jean-Pierre Serre</td>
<td>Algebraic K-theory launched by explicit analogy of ring theory with geometric cases.</td>
</tr>
<tr>
<td>1960</td>
<td>Alexander Grothendieck</td>
<td>Fiber functors</td>
</tr>
<tr>
<td>1960</td>
<td>Daniel Kan</td>
<td>Kan extensions</td>
</tr>
<tr>
<td>1960</td>
<td>Alexander Grothendieck</td>
<td>Formal algebraic geometry and formal schemes</td>
</tr>
<tr>
<td>1960</td>
<td>Alexander Grothendieck</td>
<td>Representable functors</td>
</tr>
<tr>
<td>1960</td>
<td>Alexander Grothendieck</td>
<td>Categorizes Galois theory (Grothendieck's Galois theory)</td>
</tr>
<tr>
<td>1960</td>
<td>Alexander Grothendieck</td>
<td>Descent theory: An idea extending the notion of gluing in topology to scheme to get around the brute equivalence relations. It also generalizes localization in topology</td>
</tr>
<tr>
<td>1961</td>
<td>Alexander Grothendieck</td>
<td>Local cohomology. Introduced at a seminar in 1961 but the notes are published in 1967</td>
</tr>
<tr>
<td>1961</td>
<td>Jim Stasheff</td>
<td>Associahedra later used in the definition of weak n-categories</td>
</tr>
<tr>
<td>1961</td>
<td>Richard Swan</td>
<td>Shows there is a 1-1 correspondence between topological vector bundles over a compact Hausdorff space X and finitely generated projective modules over the ring C(X) of continuous functions on X (Serre–Swan theorem)</td>
</tr>
<tr>
<td>1963</td>
<td>Frank Adams–Saunders Mac</td>
<td>PROP categories and PACT categories for higher homotopies. PROPs are categories for describing families of operations with any number of inputs and outputs. Operads are</td>
</tr>
<tr>
<td>Year</td>
<td>Author(s)</td>
<td>Contribution</td>
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</tr>
<tr>
<td>1963</td>
<td>Lane</td>
<td>special PROPs with operations with only one output</td>
</tr>
<tr>
<td>1963</td>
<td>Alexander Grothendieck</td>
<td>Etale topology, a special Grothendieck topology on</td>
</tr>
<tr>
<td>1963</td>
<td>Alexander Grothendieck</td>
<td>Etale cohomology</td>
</tr>
<tr>
<td>1963</td>
<td>Alexander Grothendieck</td>
<td>Grothendieck toposes, which are categories which are like universes (generalized spaces) of sets in which one can do mathematics</td>
</tr>
<tr>
<td>1963</td>
<td>William Lawvere</td>
<td>Algebraic theories and algebraic categories</td>
</tr>
<tr>
<td>1963</td>
<td>William Lawvere</td>
<td>Founds Categorical logic, discovers internal logics of categories and recognizes its importance and introduces Lawvere theories. Essentially categorical logic is a lift of different logics to being internal logics of categories. Each kind of category with extra structure corresponds to a system of logic with its own inference rules. A Lawvere theory is an algebraic theory as a category with finite products and possessing a &quot;generic algebra&quot; (a generic group). The structures described by a Lawvere theory are models of the Lawvere theory</td>
</tr>
<tr>
<td>1963</td>
<td>Jean-Louis Verdier</td>
<td>Triangulated categories and triangulated functors. Derived categories and derived functors are special cases of these</td>
</tr>
<tr>
<td>1963</td>
<td>Jim Stasheff</td>
<td>$A_{\infty}$-algebras: dg-algebra analogs of topological monoids associative up to homotopy appearing in topology (i.e. H-spaces)</td>
</tr>
<tr>
<td>1963</td>
<td>Jean Giraud</td>
<td>Giraud characterization theorem characterizing Grothendieck toposes as categories of sheaves over a small site</td>
</tr>
<tr>
<td>1963</td>
<td>Charles Ehresmann</td>
<td>Internal category theory: Internalization of categories in a category $V$ with pullbacks is replacing the category $Set$ (same for classes instead of sets) by $V$ in the definition of a category. Internalization is a way to rise the categorical dimension</td>
</tr>
<tr>
<td>1963</td>
<td>Charles Ehresmann</td>
<td>Multiple categories and multiple functors</td>
</tr>
<tr>
<td>1963</td>
<td>Saunders Mac Lane</td>
<td>Monoidal categories also called tensor categories: Strict 2-categories with one object made by a relabelling trick to categories with a tensor product of objects that is secretly the composition of morphisms in the 2-category. There are several object in a monoidal category since the relabelling trick makes 2-morphisms of the 2-category to morphisms, morphisms of the 2-category to objects and forgets about the single object. In general a higher relabelling trick works for n-categories with one object to make general monoidal categories. The most common examples include: ribbon categories, braided tensor categories, spherical categories, compact closed categories, symmetric tensor categories, modular categories, autonomous categories, categories with duality</td>
</tr>
<tr>
<td>Year</td>
<td>Authors</td>
<td>Description</td>
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<tr>
<td>1963</td>
<td>Saunders Mac Lane</td>
<td>Mac Lane coherence theorem for determining commutativity of diagrams in monoidal categories</td>
</tr>
<tr>
<td>1964</td>
<td>William Lawvere</td>
<td>ETCS Elementary Theory of the Category of Sets: An axiomatization of the category of sets which is also the constant case of an elementary topos</td>
</tr>
<tr>
<td>1964</td>
<td>Barry Mitchell–Peter Freyd</td>
<td>Mitchell–Freyd embedding theorem: Every small abelian category admits an exact and full embedding into the category of (left) modules Mod(_R) over some ring (R)</td>
</tr>
<tr>
<td>1964</td>
<td>Rudolf Haag–Daniel Kastler</td>
<td>Algebraic quantum field theory after ideas of Irving Segal</td>
</tr>
<tr>
<td>1964</td>
<td>Alexander Grothendieck</td>
<td>Topologizes categories axiomatically by imposing a Grothendieck topology on categories which are then called sites. The purpose of sites is to define coverings on them so sheaves over sites can be defined. The other &quot;spaces&quot; one can define sheaves for except topological spaces are locales</td>
</tr>
<tr>
<td>1964</td>
<td>Alexander Grothendieck</td>
<td>Proves the Weil conjectures except the analogue of the Riemann hypothesis</td>
</tr>
<tr>
<td>1964</td>
<td>Alexander Grothendieck</td>
<td>Six operations formalism in homological algebra; (Rf^*, f^!, Rf_!, f_!, \otimes^, \text{RHom, and proof of its closedness})</td>
</tr>
</tbody>
</table>
| 1964 | Alexander Grothendieck | Introduced in a letter to Jean-Pierre Serre conjectural motives (algebraic geometry) to express the idea that there is a single universal cohomology theory underlying the various cohomology theories for algebraic varieties. According to Grothendieck's philosophy there should be a universal cohomology functor attaching a pure motive \(h(X)\) to each smooth projective variety \(X\). When \(X\) is not smooth or projective \(h(X)\) must be replaced by a more general mixed motive which has a weight filtration whose quotients are pure motivess. The category of motives (the categorical framework for the universal cohomology theory) may be used as an abstract substitute for singular cohomology (and rational cohomology) to compare, relate and unite "motivated" properties and parallel phenomena of the various cohomology theories and to detect topological structure of algebraic varieties. The categories of pure motives and of mixed motives are abelian tensor categories and the category of pure motives is also a Tannakian category. Categories of motives are made by replacing the category of varieties by a category with the same objects but whose morphisms are correspondences, modulo a suitable equivalence relation. Different equivalences give different theories. Rational equivalence gives the category of Chow motives with Chow groups as morphisms which are in some sense universal. Every geometric cohomology theory is a functor on the
The category of motives. Each induced functor \( \rho \) : motives modulo numerical equivalence → graded \( \mathbb{Q} \)-vector spaces is called a realization of the category of motives, the inverse functors are called improvements. Mixed motives explain phenomena in as diverse areas as: Hodge theory, algebraic K-theory, polylogarithms, regulator maps, automorphic forms, L-functions, \( \ell \)-adic representations, trigonometric sums, homotopy of algebraic varieties, algebraic cycles, moduli spaces and thus has the potential of enriching each area and of unifying them all.

1965 Edgar Brown
Abstract homotopy categories: A proper framework for the study of homotopy theory of CW complexes

1965 Max Kelly
dg-categories

1965 Max Kelly–Samuel Eilenberg
Enriched category theory: Categories C enriched over a category V are categories with Hom-sets \( \text{Hom}_C \) not just a set or class but with the structure of objects in the category V. Enrichment over V is a way to raise the categorical dimension

1965 Charles Ehresmann
Defines both strict 2-categories and strict n-categories

1966 Alexander Grothendieck
Crystals (a kind of sheaf used in crystalline cohomology)

1966 William Lawvere
ETAC Elementary theory of abstract categories, first proposed axioms for Cat or category theory using first order logic

1967 Jean Bénabou
Bicategories (weak 2-categories) and weak 2-functors

1967 William Lawvere
Founds synthetic differential geometry

1967 Simon Kochen–Ernst Specker
Kochen–Specker theorem in quantum mechanics

1967 Jean-Louis Verdier
Defines derived categories and redefines derived functors in terms of derived categories

1967 Peter Gabriel–Michel Zisman
Axiomatizes simplicial homotopy theory

1967 Daniel Quillen
Quillen Model categories and Quillen model functors: A framework for doing homotopy theory in an axiomatic way in categories and an abstraction of homotopy categories in such a way that \( hC = C[W^{-1}] \) where \( W^{-1} \) are the inverted weak equivalences of the Quillen model category C. Quillen model categories are homotopically complete and cocomplete, and come with a built-in Eckmann–Hilton duality

1967 Daniel Quillen
Homotopical algebra (published as a book and also sometimes called noncommutative homological algebra): The study of various model categories and the interplay between fibrations, cofibrations and weak equivalences in arbitrary closed model categories
<table>
<thead>
<tr>
<th>Year</th>
<th>Author/Contributor</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1967</td>
<td>Daniel Quillen</td>
<td>Quillen axioms for homotopy theory in model categories</td>
</tr>
<tr>
<td>1967</td>
<td>Daniel Quillen</td>
<td>First fundamental theorem of simplicial homotopy theory: The category of simplicial sets is a (proper) closed (simplicial) model category</td>
</tr>
<tr>
<td>1967</td>
<td>Daniel Quillen</td>
<td>Second fundamental theorem of simplicial homotopy theory: The realization functor and the singular functor is an equivalence of categories hΔ and hTop (Δ the category of simplicial sets)</td>
</tr>
<tr>
<td>1967</td>
<td>Jean Bénabou</td>
<td>V-actegories: A category C with an action ( \otimes : V \times C \to C ) which is associative and unital up to coherent isomorphism, for V a symmetric monoidal category. V-actegories can be seen as the categorification of R-modules over a commutative ring R</td>
</tr>
<tr>
<td>1967</td>
<td>Chen-Ning Yang</td>
<td>Yang–Baxter equation, later used as a relation in braided monoidal categories for crossings of braids</td>
</tr>
<tr>
<td>1968</td>
<td>Alexander Grothendieck</td>
<td>Crystalline cohomology: A p-adic cohomology theory in characteristic p invented to fill the gap left by étale cohomology which is deficient in using mod p coefficients for this case. It is sometimes referred to by Grothendieck as the yoga of de Rham coefficients and Hodge coefficients since crystalline cohomology of a variety X in characteristic p is like de Rham cohomology mod p of X and there is an isomorphism between de Rham cohomology groups and Hodge cohomology groups of harmonic forms</td>
</tr>
<tr>
<td>1968</td>
<td>Alexander Grothendieck</td>
<td>Grothendieck connection</td>
</tr>
<tr>
<td>1968</td>
<td>Alexander Grothendieck</td>
<td>Formulates the standard conjectures on algebraic cycles</td>
</tr>
<tr>
<td>1968</td>
<td>Michael Artin</td>
<td>Algebraic spaces in algebraic geometry as a generalization of Scheme</td>
</tr>
<tr>
<td>1968</td>
<td>Charles Ehresmann</td>
<td>Sketches (category theory): An alternative way of presenting a theory (which is categorical in character as opposed to linguistic) whose models are to study in appropriate categories. A sketch is a small category with a set of distinguished cones and a set of distinguished cocones satisfying some axioms. A model of a sketch is a set-valued functor transforming the distinguished cones into limit cones and the distinguished cocones into colimit cones. The categories of models of sketches are exactly the accessible categories</td>
</tr>
<tr>
<td>1968</td>
<td>Joachim Lambek</td>
<td>Multicategories</td>
</tr>
<tr>
<td>1969</td>
<td>Max Kelly-Nobuo Yoneda</td>
<td>Ends and coends</td>
</tr>
<tr>
<td>1969</td>
<td>Pierre Deligne-David Mumford</td>
<td>Deligne–Mumford stacks as a generalization of scheme</td>
</tr>
<tr>
<td>1969</td>
<td>William</td>
<td>Doctrines (category theory), a doctrine is a monad on a 2-category</td>
</tr>
<tr>
<td>1970</td>
<td>Lawvere-Lawvere-Myles Tierney</td>
<td>Elementary topoi: Categories modeled after the category of sets which are like universes (generalized spaces) of sets in which one can do mathematics. One of many ways to define a topos is: a properly cartesian closed category with a subobject classifier. Every Grothendieck topos is an elementary topos</td>
</tr>
<tr>
<td>1970</td>
<td>John Conway</td>
<td>Skein theory of knots: The computation of knot invariants by skein modules. Skein modules can be based on quantum invariants</td>
</tr>
</tbody>
</table>

### 1971–1980

<table>
<thead>
<tr>
<th>Year</th>
<th>Contributors</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1971</td>
<td>Saunders Mac Lane</td>
<td>Influential book: <em>Categories for the Working Mathematician</em>, which became the standard reference in category theory</td>
</tr>
<tr>
<td>1971</td>
<td>Horst Herrlich–Oswald Wyler</td>
<td>Categorical topology: The study of topological categories of structured sets (generalizations of topological spaces, uniform spaces and the various other spaces in topology) and relations between them, culminating in universal topology. General categorical topology study and uses structured sets in a topological category as general topology study and uses topological spaces. Algebraic categorical topology tries to apply the machinery of algebraic topology for topological spaces to structured sets in a topological category.</td>
</tr>
<tr>
<td>1971</td>
<td>Harold Temperley–Elliott Lieb</td>
<td>Temperley–Lieb algebras: Algebras of tangles defined by generators of tangles and relations among them</td>
</tr>
<tr>
<td>1971</td>
<td>William Lawvere–Myles Tierney</td>
<td>Lawvere–Tierney topology on a topos</td>
</tr>
<tr>
<td>1971</td>
<td>William Lawvere–Myles Tierney</td>
<td>Topos theoretic forcing (forcing in toposes): Categorization of the set theoretic forcing method to toposes for attempts to prove or disprove the continuum hypothesis, independence of the axiom of choice, etc. in toposes</td>
</tr>
<tr>
<td>1971</td>
<td>Bob Walters–Ross Street</td>
<td>Yoneda structures on 2-categories</td>
</tr>
<tr>
<td>1971</td>
<td>Roger Penrose</td>
<td>String diagrams to manipulate morphisms in a monoidal category</td>
</tr>
<tr>
<td>1971</td>
<td>Jean Giraud</td>
<td>Gerbes: Categorified principal bundles that are also special cases of stacks</td>
</tr>
<tr>
<td>1971</td>
<td>Joachim Lambek</td>
<td>Generalizes the Haskell–Curry–William–Howard correspondence to a three way isomorphism between types, propositions and objects of a cartesian closed category</td>
</tr>
<tr>
<td>1972</td>
<td>Max Kelly</td>
<td>Clubs (category theory) and coherence (category theory). A club is a special kind of 2-dimensional theory or a monoid in Cat/(category of finite sets and...</td>
</tr>
<tr>
<td>Year</td>
<td>Author(s)</td>
<td>Contributions</td>
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<td>------</td>
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<tr>
<td>1972</td>
<td>John Isbell</td>
<td>Locales: A &quot;generalized topological space&quot; or &quot;pointless spaces&quot; defined by a lattice (a complete Heyting algebra also called a Brouwer lattice) just as for a topological space the open subsets form a lattice. If the lattice possess enough points it is a topological space. Locales are the main objects of pointless topology, the dual objects being frames. Both locales and frames form categories that are each other's opposite. Sheaves can be defined over locales. The other &quot;spaces&quot; one can define sheaves over are sites. Although locales were known earlier John Isbell first named them.</td>
</tr>
<tr>
<td>1972</td>
<td>Peter Freyd</td>
<td>Fundamental theorem of topos theory: Every slice category (E,Y) of a topos E is a topos and the functor f*:E(X)→(E,Y) preserves exponentials and the subobject classifier object Ω and has a right and left adjoint functor.</td>
</tr>
<tr>
<td>1972</td>
<td>Alexander Grothendieck</td>
<td>Grothendieck universes for sets as part of foundations for categories.</td>
</tr>
<tr>
<td>1972</td>
<td>Jean Bénabou–Ross Street</td>
<td>Cosmoses which categorize universes: A cosmos is a generalized universe of 1-categories in which you can do category theory. When set theory is generalized to the study of a Grothendieck topos, the analogous generalization of category theory is the study of a cosmos.</td>
</tr>
<tr>
<td></td>
<td>Ross Street</td>
<td>1. Ross Street definition: A bicategory such that 2. small bicoproducts exist; 3. each monad admits a Kleisli construction (analogous to the quotient of an equivalence relation in a topos); 4. it is locally small-cocomplete; and 5. there exists a small Cauchy generator.</td>
</tr>
<tr>
<td></td>
<td>Jean Bénabou–Ross Street</td>
<td>Cosmoses are closed under dualization, parametrization and localization. Ross Street also introduces elementary cosmoses. Jean Bénabou definition: A bicomplete symmetric monoidal closed category.</td>
</tr>
</tbody>
</table>
| 1972 | Peter May | Operads: An abstraction of the family of composable functions of several variables together with an action of permutation of variables. Operads can be seen as algebraic theories and algebras over operads are then models of the theories. Each operad gives a monad on Top. Multicategories with one object are operads. PROPs generalize operads to admit operations with several inputs and several outputs. Operads are used in defining opetopes, higher category theory, homotopy theory, homological algebra, algebraic geometry, string
<table>
<thead>
<tr>
<th>Year</th>
<th>Authors</th>
<th>Note</th>
</tr>
</thead>
</table>
| 1972 | William Mitchell–Jean Bénabou | **Mitchell–Bénabou internal language of a toposes:** For a topos \(E\) with subobject classifier object \(\Omega\) a language (or type theory) \(L(E)\) where:  
1) the types are the objects of \(E\)  
2) terms of type \(X\) in the variables \(x_i\) of type \(X_i\) are polynomial expressions \(\varphi(x_1,\ldots,x_m):1\rightarrow X\) in the arrows \(x_i:1\rightarrow X_i\) in \(E\)  
3) formulas are terms of type \(\Omega\) (arrows from types to \(\Omega\))  
4) connectives are induced from the internal Heyting algebra structure of \(\Omega\)  
5) quantifiers bounded by types and applied to formulas are also treated  
6) for each type \(X\) there are also two binary relations \(=_X\) (defined applying the diagonal map to the product term of the arguments) and \(\in X\) (defined applying the evaluation map to the product of the term and the power term of the arguments).  
A formula is true if the arrow which interprets it factor through the arrow true: \(1\rightarrow \Omega\). The Mitchell-Bénabou internal language is a powerful way to describe various objects in a topos as if they were sets and hence is a way of making the topos into a generalized set theory, to write and prove statements in a topos using first order intuitionistic predicate logic, to consider toposes as type theories and to express properties of a topos. Any language \(L\) also generates a linguistic topos \(E(L)\) |
<p>| 1973 | Chris Reedy | <strong>Reedy categories:</strong> Categories of &quot;shapes&quot; that can be used to do homotopy theory. A Reedy category is a category (R) equipped with a structure enabling the inductive construction of diagrams and natural transformations of shape (R). The most important consequence of a Reedy structure on (R) is the existence of a model structure on the functor category (M^R) whenever (M) is a model category. Another advantage of the Reedy structure is that its cofibrations, fibrations and factorizations are explicit. In a Reedy category there is a notion of an injective and a surjective morphism such that any morphism can be factored uniquely as a surjection followed by an injection. Examples are the ordinal (\alpha) considered as a poset and hence a category. The opposite (R^o) of a Reedy category (R) is a Reedy category. The simplex category (\Delta) and more generally for any simplicial set (X) its category of simplices (\Delta/X) is a Reedy category. The model structure on (M^\Delta) for a model category (M) is described in an unpublished manuscript by Chris Reedy |
| 1973 | Kenneth Brown–Stephen Gersten | Shows the existence of a global closed model structure on the category of simplicial sheaves on a topological space, with weak assumptions on the topological space |</p>
<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1973</td>
<td>Kenneth Brown</td>
<td>Generalized sheaf cohomology of a topological space X with coefficients a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>sheaf on X with values in Kans category of spectra with some finiteness</td>
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<tr>
<td></td>
<td></td>
<td>conditions. It generalizes generalized cohomology theory and sheaf</td>
</tr>
<tr>
<td></td>
<td></td>
<td>cohomology with coefficients in a complex of abelian sheaves</td>
</tr>
<tr>
<td>1973</td>
<td>William Lawvere</td>
<td>Finds that Cauchy completeness can be expressed for general enriched</td>
</tr>
<tr>
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<td>categories with the category of generalized metric spaces as a special case.</td>
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<tr>
<td></td>
<td></td>
<td>Cauchy sequences become left adjoint modules and convergence become</td>
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<tr>
<td></td>
<td></td>
<td>representability</td>
</tr>
<tr>
<td>1973</td>
<td>Jean Bénabou</td>
<td>Distributors (also called modules, profunctors, directed bridges)</td>
</tr>
<tr>
<td>1973</td>
<td>Pierre Deligne</td>
<td>Proves the last of the Weil conjectures, the analogue of the Riemann</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hypothesis</td>
</tr>
<tr>
<td>1973</td>
<td>Michael Boardman–Rainer Vogt</td>
<td>Segal categories: Simplicial analogues of $\mathcal{A}$-categories. They naturally generalize simplicial categories, in that they can be regarded as simplicial categories with composition only given up to homotopy.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Def: A simplicial space $X$ such that $X_0$ (the set of points) is a discrete simplicial set and the Segal map $q_k : X_k \to X_1 \times \ldots \times X_0 X_1$ (induced by $X(\alpha) : X_k \to X_1$) assigned to $X$ is a weak equivalence of simplicial sets for $k \geq 2$.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Segal categories are a weak form of S-categories, in which composition is only defined up to a coherent system of equivalences.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Segal categories were defined one year later implicitly by Graeme Segal. They were named Segal categories first by William Dwyer–Daniel Kan–Jeffrey Smith 1989. In their famous book Homotopy invariant algebraic structures on topological spaces J. Michael Boardman and Rainer Vogt called them quasi-categories. A quasi-category is a simplicial set satisfying the weak Kan condition, so quasi-categories are also called weak Kan complexes.</td>
</tr>
<tr>
<td>1973</td>
<td>Daniel Quillen</td>
<td>Frobenius categories: An exact category in which the classes of injective and projective objects coincide and for all objects $x$ in the category there is a deflation $P(x) \to x$ (the projective cover of $x$) and an inflation $x \to I(x)$ (the injective hull of $x$) such that both $P(x)$ and $I(x)$ are in the category of pro/injective objects. A Frobenius category $E$ is an example of a model category and the quotient $E/P$ (P is the class of projective/injective objects) is its homotopy category $hE$.</td>
</tr>
<tr>
<td>1974</td>
<td>Michael Artin</td>
<td>Generalizes Deligne–Mumford stacks to Artin stacks</td>
</tr>
<tr>
<td>1974</td>
<td>Robert Paré</td>
<td>Paré monadicity theorem: $E$ is a topos $\to E^\circ$ is monadic over $E$.</td>
</tr>
<tr>
<td>1974</td>
<td>Andy Magid</td>
<td>Generalizes Grothendieck's Galois theory from groups to the case of rings using</td>
</tr>
<tr>
<td>Year</td>
<td>Author(s)</td>
<td>Contribution</td>
</tr>
<tr>
<td>------</td>
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</tr>
<tr>
<td>1974</td>
<td>Jean Bénabou</td>
<td>Logic of fibred categories</td>
</tr>
<tr>
<td>1974</td>
<td>John Gray</td>
<td>Gray categories with Gray tensor product</td>
</tr>
<tr>
<td>1974</td>
<td>Kenneth Brown</td>
<td>Writes a very influential paper that defines Brown's categories of fibrant objects and dually Brown categories of cofibrant objects</td>
</tr>
<tr>
<td>1974</td>
<td>Shiing-Shen Chern–James Simons</td>
<td>Chern–Simons theory: A particular TQFT which describe knot and manifold invariants, at that time only in 3D</td>
</tr>
<tr>
<td>1975</td>
<td>Saul Kripke–André Joyal</td>
<td>Kripke–Joyal semantics of the Mitchell–Bénabou internal language for toposes: The logic in categories of sheaves is first order intuitionistic predicate logic</td>
</tr>
<tr>
<td>1975</td>
<td>Radu Diaconescu</td>
<td>Diaconescu theorem: The internal axiom of choice holds in a topos $\implies$ the topos is a boolean topos. So in IZF the axiom of choice implies the law of excluded middle</td>
</tr>
<tr>
<td>1975</td>
<td>Manfred Szabo</td>
<td>Polycategories</td>
</tr>
<tr>
<td>1975</td>
<td>William Lawvere</td>
<td>Observes that Deligne's theorem about enough points in a coherent topos implies the Gödel completeness theorem for first order logic in that topos</td>
</tr>
<tr>
<td>1976</td>
<td>Alexander Grothendieck</td>
<td>Schematic homotopy types</td>
</tr>
<tr>
<td>1976</td>
<td>Marcel Crabbe</td>
<td>Heyting categories also called logoses: Regular categories in which the subobjects of an object form a lattice, and in which each inverse image map has a right adjoint. More precisely, a coherent category $C$ such that for all morphisms $f: A \to B$ in $C$ the functor $f^*: \text{Sub}_C(B) \to \text{Sub}_C(A)$ has a left adjoint and a right adjoint. $\text{Sub}_C(A)$ is the preorder of subobjects of $A$ (the full subcategory of $C/A$ whose objects are subobjects of $A$) in $C$. Every topos is a logos. Heyting categories generalize Heyting algebras.</td>
</tr>
<tr>
<td>1976</td>
<td>Ross Street</td>
<td>Computads</td>
</tr>
<tr>
<td>1977</td>
<td>Michael Makkai–Gonzalo Reyes</td>
<td>Develops the Mitchell–Bénabou internal language of a topos thoroughly in a more general setting</td>
</tr>
<tr>
<td>1977</td>
<td>André Boileau–André Joyal–John Zangwill</td>
<td>LST Local set theory: Local set theory is a typed set theory whose underlying logic is higher order intuitionistic logic. It is a generalization of classical set theory, in which sets are replaced by terms of certain types. The category $C(S)$ built out of a local theory $S$ whose objects are the local sets (or $S$-sets) and whose arrows are the local maps (or $S$-maps) is a linguistic topos. Every topos $E$ is equivalent to a linguistic topos $C(S(E))$</td>
</tr>
<tr>
<td>1977</td>
<td>John Roberts</td>
<td>Introduces most general nonabelian cohomology of $\omega$-categories with $\omega$-categories as coefficients when he realized that general cohomology is about coloring simplices in $\omega$-categories. There are two methods of constructing general nonabelian cohomology, as nonabelian sheaf cohomology in terms</td>
</tr>
</tbody>
</table>
of descent for $\infty$-category valued sheaves, and in terms of homotopical cohomology theory which realizes the cocycles. The two approaches are related by codescent.

<table>
<thead>
<tr>
<th>Year</th>
<th>Contributors</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>1978</td>
<td>John Roberts</td>
<td>Complicial sets (simplicial sets with structure or enchantment)</td>
</tr>
<tr>
<td>1978</td>
<td>Francois Bayen–Moshe Flato–Chris Fronsdal–André Lichnerowicz–Daniel Sternheimer</td>
<td>Deformation quantization, later to be a part of categorical quantization</td>
</tr>
<tr>
<td>1978</td>
<td>André Joyal</td>
<td>Combinatorial species in enumerative combinatorics</td>
</tr>
<tr>
<td>1978</td>
<td>Don Anderson</td>
<td>Building on work of Kenneth Brown defines ABC (co)fibration categories for doing homotopy theory and more general ABC model categories, but the theory lies dormant until 2003. Every Quillen model category is an ABC model category. A difference to Quillen model categories is that in ABC model categories fibrations and cofibrations are independent and that for an ABC model category $M^P$ is an ABC model category. To an ABC (co)fibration category is canonically associated a (left) right Heller derivator. Topological spaces with homotopy equivalences as weak equivalences, Hurewicz cofibrations as cofibrations and Hurewicz fibrations as fibrations form an ABC model category, the Hurewicz model structure on Top. Complexes of objects in an abelian category with quasi-isomorphisms as weak equivalences and monomorphisms as cofibrations form an ABC pre cofibration category</td>
</tr>
<tr>
<td>1979</td>
<td>Don Anderson</td>
<td>Anderson axioms for homotopy theory in categories with a fraction functor</td>
</tr>
<tr>
<td>1980</td>
<td>Alexander Zamolodchikov</td>
<td>Zamolodchikov equation also called tetrahedron equation</td>
</tr>
<tr>
<td>1980</td>
<td>Ross Street</td>
<td>Bicategorical Yoneda lemma</td>
</tr>
<tr>
<td>1980</td>
<td>Masaki Kashiwara–Zoghman Mebkhout</td>
<td>Proves the Riemann–Hilbert correspondence for complex manifolds</td>
</tr>
<tr>
<td>1980</td>
<td>Peter Freyd</td>
<td>Numerals in a topos</td>
</tr>
</tbody>
</table>

**1981–1990**

<table>
<thead>
<tr>
<th>Year</th>
<th>Contributors</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1981</td>
<td>Shigeru Mukai</td>
<td>Mukai–Fourier transform</td>
</tr>
<tr>
<td>1982</td>
<td>Bob Walters</td>
<td>Enriched categories with bicategories as a base</td>
</tr>
<tr>
<td>1983</td>
<td>Alexander Grothendieck</td>
<td>Pursuing stacks: Manuscript circulated from Bangor, written in English in response to a correspondence in English with Ronald Brown and Tim Porter, starting with a</td>
</tr>
<tr>
<td>Year</td>
<td>Author(s)</td>
<td>Description</td>
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</tr>
<tr>
<td>1983</td>
<td>Alexander Grothendieck</td>
<td>Letter addressed to Daniel Quillen, developing mathematical visions in a 629 pages manuscript, a kind of diary, and to be published by the Société Mathématique de France, edited by G. Maltsiniotis.</td>
</tr>
<tr>
<td>1983</td>
<td>Alexander Grothendieck</td>
<td>Fundamental infinity groupoid: A complete homotopy invariant $\Pi_n(X)$ for CW-complexes $X$. The inverse functor is the geometric realization functor $</td>
</tr>
<tr>
<td>1983</td>
<td>Alexander Grothendieck</td>
<td>Homotopy hypothesis: The homotopy category of CW-complexes is Quillen equivalent to a homotopy category of reasonable weak $\infty$-groupoids.</td>
</tr>
<tr>
<td>1983</td>
<td>Alexander Grothendieck</td>
<td>Grothendieck derivators: A model for homotopy theory similar to Quillen model categories but more satisfactory. Grothendieck derivators are dual to Heller derivators.</td>
</tr>
<tr>
<td>1983</td>
<td>Alexander Grothendieck</td>
<td>Elementary modelizers: Categories of presheaves that modelize homotopy types (thus generalizing the theory of simplicial sets). Canonical modelizers are also used in pursuing stacks.</td>
</tr>
<tr>
<td>1983</td>
<td>Alexander Grothendieck</td>
<td>Smooth functors and proper functors.</td>
</tr>
<tr>
<td>1984</td>
<td>Vladimir Bazhanov</td>
<td>$\pm$ Stroganov d-simplex equation generalizing the Yang–Baxter equation and the Zamolodchikov equation.</td>
</tr>
<tr>
<td>1984</td>
<td>Horst Herrlich</td>
<td>Universal topology in categorical topology: A unifying categorical approach to the different structured sets (topological structures such as topological spaces and uniform spaces) whose class form a topological category similar as universal algebra is for algebraic structures.</td>
</tr>
<tr>
<td>1984</td>
<td>André Joyal</td>
<td>Simplicial sheaves (sheaves with values in simplicial sets). Simplicial sheaves on a topological space $X$ is a model for the hypercomplete $\infty$-topos $\text{Sh}(X)^\wedge$.</td>
</tr>
<tr>
<td>1984</td>
<td>André Joyal</td>
<td>Shows that the category of simplicial objects in a Grothendieck topos has a closed model structure.</td>
</tr>
<tr>
<td>1984</td>
<td>André Joyal–Myles Tierney</td>
<td>Main Galois theorem for toposes: Every topos is equivalent to a category of étale presheaves on an open étale groupoid.</td>
</tr>
<tr>
<td>1985</td>
<td>André Joyal–Ross</td>
<td>Braided monoidal categories.</td>
</tr>
<tr>
<td>Year</td>
<td>Authors</td>
<td>Description</td>
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<tr>
<td>1985</td>
<td>André Joyal–Ross Street</td>
<td>Joyal–Street coherence theorem for braided monoidal categories</td>
</tr>
<tr>
<td>1985</td>
<td>Paul Ghez–Ricardo Lima–John Roberts</td>
<td>C*-categories</td>
</tr>
<tr>
<td>1986</td>
<td>Joachim Lambek–Phil Scott</td>
<td>Influential book: Introduction to higher order categorical logic</td>
</tr>
<tr>
<td>1986</td>
<td>Joachim Lambek–Phil Scott</td>
<td>Fundamental theorem of topology: The section-functor $\Gamma$ and the germ-functor $\Lambda$ establish a dual adjunction between the category of presheaves and the category of bundles (over the same topological space) which restricts to a dual equivalence of categories (or duality) between corresponding full subcategories of sheaves and of étale bundles</td>
</tr>
<tr>
<td>1986</td>
<td>Peter Freyd–David Yetter</td>
<td>Constructs the (compact braided) monoidal category of tangles</td>
</tr>
<tr>
<td>1986</td>
<td>Vladimir Drinfeld–Michio Jimbo</td>
<td>Quantum groups: In other words, quasitriangular Hopf algebras. The point is that the categories of representations of quantum groups are tensor categories with extra structure. They are used in construction of quantum invariants of knots and links and low-dimensional manifolds, representation theory, q-deformation theory, CFT, integrable systems. The invariants are constructed from braided monoidal categories that are categories of representations of quantum groups. The underlying structure of a TQFT is a modular category of representations of a quantum group</td>
</tr>
<tr>
<td>1986</td>
<td>Saunders Mac Lane</td>
<td>Mathematics, form and function (a foundation of mathematics)</td>
</tr>
<tr>
<td>1987</td>
<td>Jean-Yves Girard</td>
<td>Linear logic: The internal logic of a linear category (an enriched category with its Hom-sets being linear spaces)</td>
</tr>
<tr>
<td>1987</td>
<td>Peter Freyd</td>
<td>Freyd representation theorem for Grothendieck toposes</td>
</tr>
<tr>
<td>1987</td>
<td>Ross Street</td>
<td>Definition of the nerve of a weak n-category and thus obtaining the first definition of Weak n-category using simplices</td>
</tr>
<tr>
<td>1987</td>
<td>Ross Street–John Roberts</td>
<td>Formulates Street–Roberts conjecture: Strict $\omega$-categories are equivalent to complicial sets</td>
</tr>
<tr>
<td>1987</td>
<td>André Joyal–Ross Street–Mei Chee Shum</td>
<td>Ribbon categories: A balanced rigid braided monoidal category</td>
</tr>
<tr>
<td>1987</td>
<td>Ross Street</td>
<td>n-computads</td>
</tr>
<tr>
<td>1987</td>
<td>Iain Aitchison</td>
<td>Bottom up Pascal triangle algorithm for computing nonabelian n-cocycle conditions for nonabelian cohomology</td>
</tr>
<tr>
<td>1987</td>
<td>Vladimir Drinfeld-</td>
<td>Formulates geometric Langlands program</td>
</tr>
<tr>
<td>Year</td>
<td>Author(s)</td>
<td>Contribution</td>
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<td>------</td>
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</tr>
<tr>
<td>1987</td>
<td>Gérard Laumon</td>
<td>Starts quantum topology by using quantum groups and R-matrices to giving an algebraic unification of most of the known knot polynomials. Especially important was Vaughan Jones and Edward Witten's work on the Jones polynomial.</td>
</tr>
<tr>
<td>1988</td>
<td>Alex Heller</td>
<td>Heller axioms for homotopy theory as a special abstract hyperfunctor. A feature of this approach is a very general localization.</td>
</tr>
<tr>
<td>1988</td>
<td>Alex Heller</td>
<td>Heller derivators, the dual of Grothendieck derivators.</td>
</tr>
<tr>
<td>1988</td>
<td>Alex Heller</td>
<td>Gives a global closed model structure on the category of simplicial presheaves. John Jardine has also given a model structure in the category of simplicial presheaves.</td>
</tr>
<tr>
<td>1988</td>
<td>Graeme Segal</td>
<td>Elliptic objects: A functor that is a categorified version of a vector bundle equipped with a connection, it is a 2D parallel transport for strings.</td>
</tr>
<tr>
<td>1988</td>
<td>Graeme Segal</td>
<td>Conformal field theory CFT: A symmetric monoidal functor $\mathcal{C} : \text{nCob}_c \rightarrow \text{Hilb}$ satisfying some axioms.</td>
</tr>
<tr>
<td>1988</td>
<td>Edward Witten</td>
<td>Topological quantum field theory TQFT: A monoidal functor $\mathcal{Z} : \text{nCob} \rightarrow \text{Hilb}$ satisfying some axioms.</td>
</tr>
<tr>
<td>1988</td>
<td>Edward Witten</td>
<td>Topological string theory.</td>
</tr>
<tr>
<td>1989</td>
<td>Michael Makkai- Robert Paré</td>
<td>Accessible categories: Categories with a &quot;good&quot; set of generators allowing to manipulate large categories as if they were small categories, without the fear of encountering any set-theoretic paradoxes. Locally presentable categories are complete accessible categories. Accessible categories are the categories of models of sketches. The name comes from that these categories are accessible as models of sketches.</td>
</tr>
<tr>
<td>1990</td>
<td>Peter Freyd</td>
<td>Allegories (category theory): An abstraction of the category of sets and relations as morphisms, it bears the same resemblance to binary relations as categories do to functions and sets. It is a category in which one has in addition to composition a unary operation reciprocation $R^\circ$ and a partial binary operation intersection $R \cap S$, like in the category of sets with relations as morphisms (instead of functions) for which a number of axioms are required. It generalizes the relation algebra to relations between different sorts.</td>
</tr>
<tr>
<td>Year</td>
<td>Contributors</td>
<td>Event</td>
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</tr>
<tr>
<td>1991</td>
<td>Jean-Yves Girard</td>
<td>Polarization of linear logic.</td>
</tr>
<tr>
<td>1991</td>
<td>Ross Street</td>
<td>Parity complexes. A parity complex generates a free $\omega$-category.</td>
</tr>
<tr>
<td>1991</td>
<td>André Joyal-Ross Street</td>
<td>Formalization of Penrose string diagrams to calculate with abstract tensors in various monoidal categories with extra structure. The calculus now depends on the connection with low-dimensional topology.</td>
</tr>
<tr>
<td>1991</td>
<td>Ross Street</td>
<td>Definition of the descent strict $\omega$-category of a cosimplicial strict $\omega$-category.</td>
</tr>
<tr>
<td>1991</td>
<td>Ross Street</td>
<td>Top down excision of extremals algorithm for computing nonabelian $n$-cocycle conditions for nonabelian cohomology.</td>
</tr>
<tr>
<td>1992</td>
<td>Yves Diers</td>
<td>Axiomatic categorical geometry using algebraic-geometric categories and algebraic-geometric functors.</td>
</tr>
<tr>
<td>1992</td>
<td>Saunders Mac Lane-Ieke Moerdijk</td>
<td>Influential book: <em>Sheaves in geometry and logic</em>.</td>
</tr>
<tr>
<td>1992</td>
<td>John Greenlees-Peter May</td>
<td>Greenlees-May duality</td>
</tr>
<tr>
<td>1992</td>
<td>Vladimir Turaev</td>
<td>Modular tensor categories. Special tensor categories that arise in constructing knot invariants, in constructing TQFTs and CFTs, as truncation (semisimple quotient) of the category of representations of a quantum group (at roots of unity), as categories of representations of weak Hopf algebras, as category of representations of a RCFT.</td>
</tr>
<tr>
<td>1992</td>
<td>Vladimir Turaev-Oleg Viro</td>
<td>Turaev-Viro state sum models based on spherical categories (the first state sum models) and Turaev-Viro state sum invariants for 3-manifolds.</td>
</tr>
<tr>
<td>1993</td>
<td>Ruth Lawrence</td>
<td>Extended TQFTs</td>
</tr>
<tr>
<td>1993</td>
<td>David Yetter-Louis Crane</td>
<td>Crane-Yetter state sum models based on ribbon categories and Crane-Yetter state sum invariants for 4-manifolds.</td>
</tr>
<tr>
<td>1993</td>
<td>Kenji Fukaya</td>
<td>$A_\infty$-categories and $A_\infty$-functors: Most commonly in homological algebra, a category with several compositions such that the first composition is associative up to homotopy which satisfies an equation that holds up to another homotopy, etc. (associative up to higher homotopy). $A$ stands for associative. Def: A category $C$ such that 1) for all $X,Y$ in $\text{Ob}(C)$ the Hom-sets $\text{Hom}_C(X,Y)$ are finite-dimensional chain complexes of $\mathbb{Z}$-graded modules.</td>
</tr>
</tbody>
</table>
2) for all objects $X_1,...,X_n$ in $\text{Ob}(C)$ there is a family of linear composition maps (the higher compositions) 

$$m_n: \text{Hom}_C(X_0,X_1) \otimes \text{Hom}_C(X_1,X_2) \otimes ... \otimes \text{Hom}_C(X_{n-1},X_n) \to \text{Hom}_C(X_0,X_n)$$

degree $n - 2$ (homological grading convention is used) for $n \geq 1$

3) $m_1$ is the differential on the chain complex $\text{Hom}_C(X,Y)$

4) $m_n$ satisfy the quadratic $A_{\omega}$-associativity equation for all $n \geq 0$.

$m_1$ and $m_2$ will be chain maps but the compositions $m_i$ of higher order are not chain maps; nevertheless they are Massey products. In particular it is a linear category.

Examples are the Fukaya category $\text{Fuk}(X)$ and loop space $\Omega X$ where $X$ is a topological space and $A_{\omega}$-algebras as $A_{\omega}$-categories with one object.

When there are no higher maps (trivial homotopies) $C$ is a dg-category. Every $A_{\omega}$-category is quasiisomorphic in a functorial way to a dg-category. A quasiisomorphism is a chain map that is an isomorphism in homology.

The framework of dg-categories and dg-functors is too narrow for many problems, and it is preferable to consider the wider class of $A_{\omega}$-categories and $A_{\omega}$-functors.

Many features of $A_{\omega}$-categories and $A_{\omega}$-functors come from the fact that they form a symmetric closed multicategory, which is revealed in the language of comonads.

From a higher-dimensional perspective $A_{\omega}$-categories are weak $\omega$-categories with all morphisms invertible. $A_{\omega}$-categories can also be viewed as noncommutative formal dg-manifolds with a closed marked subscheme of objects.

<table>
<thead>
<tr>
<th>Year</th>
<th>Author</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>John Barret-Bruce Westbury</td>
<td>Spherical categories: Monoidal categories with duals for diagrams on spheres instead for in the plane.</td>
</tr>
<tr>
<td>1993</td>
<td>Maxim Kontsevich</td>
<td>Kontsevich invariants for knots (are perturbation expansion Feynman integrals for the Witten functional integral) defined by the Kontsevich integral. They are the universal Vassiliev invariants for knots.</td>
</tr>
<tr>
<td>1993</td>
<td>Daniel Freed</td>
<td>A new view on TQFT using modular tensor categories that unifies three approaches to TQFT (modular tensor categories from path integrals).</td>
</tr>
</tbody>
</table>
| 1994 | Maxim Kontsevich | Formulates the homological mirror symmetry conjecture: $X$ a compact symplectic manifold with first Chern class $c_1(X) = 0$ and $Y$ a compact Calabi–Yau manifold are mirror pairs if and only if $D(\text{Fuk}_X)$ (the derived category of the Fukaya triangulated }
<table>
<thead>
<tr>
<th>Year</th>
<th>Authors</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>1994</td>
<td>Louis Crane-Igor Frenkel</td>
<td>Hopf categories and construction of 4D TQFTs by them.</td>
</tr>
<tr>
<td>1994</td>
<td>John Fischer</td>
<td>Defines the 2-category of 2-knots (knotted surfaces).</td>
</tr>
<tr>
<td>1995</td>
<td>Bob Gordon-John Power-Ross Street</td>
<td>Tricategories and a corresponding coherence theorem: Every weak 3-category is equivalent to a Gray 3-category.</td>
</tr>
<tr>
<td>1995</td>
<td>Ross Street-Dominic Verity</td>
<td>Surface diagrams for tricategories.</td>
</tr>
<tr>
<td>1995</td>
<td>Louis Crane</td>
<td>Coins categorification leading to the categorical ladder.</td>
</tr>
<tr>
<td>1995</td>
<td>Sjoerd Crans</td>
<td>A general procedure of transferring closed model structures on a category along adjoint functor pairs to another category.</td>
</tr>
<tr>
<td>1995</td>
<td>André Joyal-Ieke Moerdijk</td>
<td>AST Algebraic set theory: Also sometimes called categorical set theory. It was developed from 1988 by André Joyal and Ieke Moerdijk, and was first presented in detail as a book in 1995 by them. AST is a framework based on category theory to study and organize set theories and to construct models of set theories. The aim of AST is to provide a uniform categorical semantics or description of set theories of different kinds (classical or constructive, bounded, predicative or impredicative, well-founded or non-well-founded,...), the various constructions of the cumulative hierarchy of sets, forcing models, sheaf models and realizability models. Instead of focusing on categories of sets AST focuses on categories of classes. The basic tool of AST is the notion of a category with class structure (a category of classes equipped with a class of small maps (the intuition being that their fibres are small in some sense), powerclasses and a universal object (a universe)) which provides an axiomatic framework in which models of set theory can be constructed. The notion of a class category permits both the definition of ZF-algebras (Zermelo-Fraenkel algebra) and related structures expressing the idea that the hierarchy of sets is an algebraic structure on the one hand and the interpretation of the first order logic of elementary set theory on the other. The subcategory of sets in a class category is an elementary topos and every elementary topos occurs as sets in a class category. The class category itself always embeds into the ideal completion of a topos. The interpretation of the logic is that in every class category the universe is a model of basic intuitionistic set theory BIST that is logically complete with respect to class category models. Therefore, class categories generalize both topos theory and intuitionistic set theory. AST founds and formalizes set theory on the ZF-algebra with operations union and successor (singleton) instead of on the membership relation.</td>
</tr>
<tr>
<td>Year</td>
<td>Author(s)</td>
<td>Contribution</td>
</tr>
<tr>
<td>------</td>
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</tr>
<tr>
<td>1995</td>
<td>Michael Makkai</td>
<td>SFAM Structural foundation of abstract mathematics. In SFAM the universe consists of higher-dimensional categories, functors are replaced by saturated anafunctors, sets are abstract sets, the formal logic for entities is FOLDS (first-order logic with dependent sorts) in which the identity relation is not given a priori by first order axioms but derived from within a context.</td>
</tr>
<tr>
<td>1995</td>
<td>John Baez-James Dolan</td>
<td>Opetopic sets (opetopes) based on operads. Weak $n$-categories are $n$-opetopic sets.</td>
</tr>
<tr>
<td>1995</td>
<td>John Baez-James Dolan</td>
<td>Introduced the periodic table of mathematics which identifies $k$-tuply monoidal $n$-categories. It mirrors the table of homotopy groups of the spheres.</td>
</tr>
<tr>
<td>1995</td>
<td>John Baez–James Dolan</td>
<td>Outlined a program in which $n$-dimensional TQFTs are described as $n$-category representations.</td>
</tr>
<tr>
<td>1995</td>
<td>John Baez–James Dolan</td>
<td>Tangle hypothesis: The $n$-category of framed $n$-tangles in $n + k$ dimensions is $(n + k)$-equivalent to the free weak $k$-tuply monoidal $n$-category with duals on one object.</td>
</tr>
<tr>
<td>1995</td>
<td>John Baez-James Dolan</td>
<td>Cobordism hypothesis (Extended TQFT hypothesis I): The $n$-category of which $n$-dimensional extended TQFTs are representations, $n$Cob, is the free stable weak $n$-category with duals on one object.</td>
</tr>
<tr>
<td>1995</td>
<td>John Baez-James Dolan</td>
<td>Stabilization hypothesis: After suspending a weak $n$-category $n + 2$ times, further suspensions have no essential effect. The suspension functor $S:n\text{Cat}<em>k \rightarrow n\text{Cat}</em>{k+1}$ is an equivalence of categories for $k = n + 2$.</td>
</tr>
<tr>
<td>1995</td>
<td>John Baez-James Dolan</td>
<td>Extended TQFT hypothesis II: An $n$-dimensional unitary extended TQFT is a weak $n$-functor, preserving all levels of duality, from the free stable weak $n$-category with duals on one object to $n\text{Hilb}$.</td>
</tr>
<tr>
<td>1995</td>
<td>Valentin Lychagin</td>
<td>Categorical quantization</td>
</tr>
<tr>
<td>1995</td>
<td>Pierre Deligne-Vladimir Drinfeld-Maxim Kontsevich</td>
<td>Derived algebraic geometry with derived schemes and derived moduli stacks. A program of doing algebraic geometry and especially moduli problems in the derived category of schemes or algebraic varieties instead of in their normal categories.</td>
</tr>
<tr>
<td>1997</td>
<td>Maxim Kontsevich</td>
<td>Formal deformation quantization theorem: Every Poisson manifold admits a...</td>
</tr>
<tr>
<td>Year</td>
<td>Authors</td>
<td>Text</td>
</tr>
<tr>
<td>------</td>
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<td>------</td>
</tr>
<tr>
<td>1998</td>
<td>Claudio Hermida-Michael-Makkai-John Power</td>
<td>Differentiable star product and they are classified up to equivalence by formal deformations of the Poisson structure.</td>
</tr>
<tr>
<td>1998</td>
<td>Carlos Simpson</td>
<td>Simpson conjecture: Every weak ( \infty )-category is equivalent to a ( \infty )-category in which composition and exchange laws are strict and only the unit laws are allowed to hold weakly. It is proven for 1,2,3-categories with a single object.</td>
</tr>
<tr>
<td>1998</td>
<td>André Hirschowitz-Carlos Simpson</td>
<td>Give a model category structure on the category of Segal categories. Segal categories are the fibrant-cofibrant objects and Segal maps are the weak equivalences. In fact they generalize the definition to that of a Segal ( n )-category and give a model structure for Segal ( n )-categories for any ( n \geq 1 ).</td>
</tr>
<tr>
<td>1998</td>
<td>Chris Isham-Jeremy Butterfield</td>
<td>Kochen–Specker theorem in topos theory of presheaves: The spectral presheaf (the presheaf that assigns to each operator its spectrum) has no global elements (global sections) but may have partial elements or local elements. A global element is the analogue for presheaves of the ordinary idea of an element of a set. This is equivalent in quantum theory to the spectrum of the C*-algebra of observables in a topos having no points.</td>
</tr>
<tr>
<td>1998</td>
<td>Richard Thomas</td>
<td>Richard Thomas, a student of Simon Donaldson, introduces Donaldson–Thomas invariants which are systems of numerical invariants of complex oriented 3-manifolds ( X ), analogous to Donaldson invariants in the theory of 4-manifolds. They are certain weighted Euler characteristics of the moduli space of sheaves on ( X ) and &quot;count&quot; Gieseker semistable coherent sheaves with fixed Chern character on ( X ). Ideally the moduli spaces should be a critical sets of holomorphic Chern–Simons functions and the Donaldson–Thomas invariants should be the number of critical points of this function, counted correctly. Currently such holomorphic Chern–Simons functions exist at best locally.</td>
</tr>
<tr>
<td>1998</td>
<td>John Baez</td>
<td>Spin foam models: A 2-dimensional cell complex with faces labeled by representations and edges labeled by intertwining operators. Spin foams are functors between spin network categories. Any slice of a spin foam gives a spin network.</td>
</tr>
<tr>
<td>1998</td>
<td>John Baez–James Dolan</td>
<td>Microcosm principle: Certain algebraic structures can be defined in any category equipped with a categorified version of the same structure.</td>
</tr>
<tr>
<td>1998</td>
<td>Alexander Rosenberg</td>
<td>Noncommutative schemes: The pair ((\text{Spec}(A),\mathcal{O}_A)) where ( A ) is an abelian category and to it is associated a topological space ( \text{Spec}(A) ) together with a sheaf of rings ( \mathcal{O}_A ) on it. In the case when ( A = \mathcal{QCoh}(X) ) for ( X ) a scheme the pair ((\text{Spec}(A),\mathcal{O}_A)) is naturally isomorphic to the scheme ((X^\text{Zar},\mathcal{O}_X)) using the equivalence of categories.</td>
</tr>
</tbody>
</table>
QCoh(Spec(R))=Mod. More generally abelian categories or triangulated categories or dg-categories or A∞-categories should be regarded as categories of quasicoherent sheaves (or complexes of sheaves) on noncommutative schemes. This is a starting point in noncommutative algebraic geometry. It means that one can think of the category A itself as a space. Since A is abelian it allows to naturally do homological algebra on noncommutative schemes and hence sheaf cohomology.

<table>
<thead>
<tr>
<th>Year</th>
<th>Author(s)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>Maxim Kontsevich</td>
<td>Calabi–Yau categories: A linear category with a trace map for each object of the category and an associated symmetric (with respects to objects) nondegenerate pairing to the trace map. If X is a smooth projective Calabi–Yau variety of dimension d then D³(Coh(X)) is a unital Calabi–Yau A∞-category of Calabi–Yau dimension d. A Calabi–Yau category with one object is a Frobenius algebra.</td>
</tr>
<tr>
<td>1999</td>
<td>Joseph Bernstein–Igor Frenkel–Mikhail Khovanov</td>
<td>Temperley–Lieb categories: Objects are enumerated by nonnegative integers. The set of homomorphisms from object n to object m is a free R-module with a basis over a ring R. R is given by the isotopy classes of systems of (</td>
</tr>
<tr>
<td>1999</td>
<td>Moira Chas–Dennis Sullivan</td>
<td>Constructs string topology by cohomology. This is string theory on general topological manifolds.</td>
</tr>
<tr>
<td>1999</td>
<td>Mikhail Khovanov</td>
<td>Khovanov homology: A homology theory for knots such that the dimensions of the homology groups are the coefficients of the Jones polynomial of the knot.</td>
</tr>
<tr>
<td>1999</td>
<td>Vladimir Turaev</td>
<td>Homotopy quantum field theory HQFT</td>
</tr>
<tr>
<td>1999</td>
<td>Vladimir Voevodsky–Fabien Morel</td>
<td>Constructs the homotopy category of schemes.</td>
</tr>
<tr>
<td>1999</td>
<td>Ronald Brown–George Janelidze</td>
<td>2-dimensional Galois theory</td>
</tr>
<tr>
<td>2000</td>
<td>Vladimir Voevodsky</td>
<td>Gives two constructions of motivic cohomology of varieties, by model categories in homotopy theory and by a triangulated category of DM-motives.</td>
</tr>
<tr>
<td>2000</td>
<td>Yasha Eliashberg–Alexander Givental–Helmut Hofer</td>
<td>Symplectic field theory SFT: A functor Z from a geometric category of framed Hamiltonian structures and framed cobordisms between them to an algebraic category of certain differential D-modules and Fourier integral operators between them and satisfying some axioms.</td>
</tr>
</tbody>
</table>
that is both constructive and computable. The topology on a space is treated not as a lattice, but as an exponential object of the same category as the original space, with an associated \( \lambda \)-calculus. Every expression in the \( \lambda \)-calculus denotes both a continuous function and a program. ASD does not use the category of sets, but the full subcategory of overt discrete objects plays this role (an overt object is the dual to a compact object), forming an arithmetic universe (pretopos with lists) with general recursion.

2001–present

<table>
<thead>
<tr>
<th>Year</th>
<th>Contributors</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2001</td>
<td>Charles Rezk</td>
<td>Constructs a model category with certain generalized Segal categories as the fibrant objects, thus obtaining a model for a homotopy theory of homotopy theories. Complete Segal spaces are introduced at the same time.</td>
</tr>
<tr>
<td>2001</td>
<td>Charles Rezk</td>
<td>Model toposes and their generalization homotopy toposes (a model topos without the t-completeness assumption).</td>
</tr>
<tr>
<td>2002</td>
<td>Bertrand Toën-Gabriele Vezzosi</td>
<td>Segal toposes coming from Segal topologies, Segal sites and stacks over them.</td>
</tr>
<tr>
<td>2002</td>
<td>Bertrand Toën-Gabriele Vezzosi</td>
<td>Homotopical algebraic geometry: The main idea is to extend schemes by formally replacing the rings with any kind of &quot;homotopy-ring-like object&quot;. More precisely this object is a commutative monoid in a symmetric monoidal category endowed with a notion of equivalences which are understood as &quot;up-to-homotopy monoid&quot; (e.g. ( E_\infty )-rings).</td>
</tr>
<tr>
<td>2002</td>
<td>Dennis Gaitsgory-Kari Vilonen-Edward Frenkel</td>
<td>Proves the geometric Langlands program for ( GL(n) ) over finite fields.</td>
</tr>
<tr>
<td>2003</td>
<td>Denis-Charles Cisinski</td>
<td>Makes further work on ABC model categories and brings them back into light. From then they are called ABC model categories after their contributors.</td>
</tr>
<tr>
<td>2004</td>
<td>Dennis Gaitsgory</td>
<td>Extended the proof of the geometric Langlands program to include ( GL(n) ) over ( \mathbb{C} ). This allows to consider curves over ( \mathbb{C} ) instead of over finite fields in the geometric Langlands program.</td>
</tr>
<tr>
<td>2004</td>
<td>Mario Caccamo</td>
<td>Formal category theoretical expanded ( \lambda )-calculus for categories.</td>
</tr>
<tr>
<td>Year</td>
<td>Authors</td>
<td>Contributions</td>
</tr>
<tr>
<td>------</td>
<td>---------</td>
<td>--------------</td>
</tr>
<tr>
<td>2004</td>
<td>Francis Borceux-Dominique Bourn</td>
<td>Homological categories</td>
</tr>
<tr>
<td>2004</td>
<td>William Dwyer-Philips Hirschhorn-Daniel Kan-Jeffrey Smith</td>
<td>Introduces in the book: Homotopy limit functors on model categories and homotopical categories, a formalism of homotopical categories and homotopical functors (weak equivalence preserving functors) that generalize the model category formalism of Daniel Quillen. A homotopical category has only a distinguished class of morphisms (containing all isomorphisms) called weak equivalences and satisfy the two out of six axiom. This allow to define homotopical versions of initial and terminal objects, limit and colimit functors (that are computed by local constructions in the book), completeness and cocompleteness, adjunctions, Kan extensions and universal properties.</td>
</tr>
<tr>
<td>2004</td>
<td>Dominic Verity</td>
<td>Proves the Street-Roberts conjecture.</td>
</tr>
<tr>
<td>2004</td>
<td>Ross Street</td>
<td>Definition of the descent weak ω-category of a cosimplicial weak ω-category.</td>
</tr>
<tr>
<td>2004</td>
<td>Ross Street</td>
<td>Characterization theorem for cosmoses: A bicategory M is a cosmos iff there exists a base bicategory W such that M is biequivalent to ModW. W can be taken to be any full subbicategory of M whose objects form a small Cauchy generator.</td>
</tr>
<tr>
<td>2004</td>
<td>Ross Street-Brian Day</td>
<td>Quantum categories and quantum groupoids: A quantum category over a braided monoidal category V is an object R with an opmorphism h:R^op ⊗ R → A into a pseudomonoid A such that h^* is strong monoidal (preserves tensor product and unit up to coherent natural isomorphisms) and all R, h and A lie in the autonomous monoidal bicategory Comod(V)^co of comonoids. Comod(V)=Mod(V^op)^coop. Quantum categories were introduced to generalize Hopf algebroids and groupoids. A quantum groupoid is a Hopf algebra with several objects.</td>
</tr>
<tr>
<td>2004</td>
<td>Stephan Stolz-Peter Teichner</td>
<td>Definition of nD QFT of degree p parametrized by a manifold.</td>
</tr>
<tr>
<td>2004</td>
<td>Stephan Stolz-Peter Teichner</td>
<td>Graeme Segal proposed in the 1980s to provide a geometric construction of elliptic cohomology (the precursor to tmf) as some kind of moduli space of CFTs. Stephan Stolz and Peter Teichner continued and expanded these ideas in a program to construct TMF as a moduli space of supersymmetric Euclidean field theories. They conjectured a Stolz-Teichner picture (analogy) between classifying spaces of cohomology theories in the chromatic filtration (de Rham cohomology, K-theory, Morava K-theories) and moduli spaces of supersymmetric QFTs parametrized by a manifold (proved in 0D and 1D).</td>
</tr>
<tr>
<td>2005</td>
<td>Peter Selinger</td>
<td>Dagger categories and dagger functors. Dagger categories seem to be part of a larger framework involving n-categories with duals.</td>
</tr>
<tr>
<td>Year</td>
<td>Authors</td>
<td>Title</td>
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<tr>
<td>------</td>
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</tr>
<tr>
<td>2005</td>
<td>Peter Ozsváth-Zoltán Szabó</td>
<td>Knot Floer homology</td>
</tr>
<tr>
<td>2006</td>
<td>P. Carrasco-A.R. Garzon-E.M. Vitale</td>
<td>Categorical crossed modules</td>
</tr>
<tr>
<td>2006</td>
<td>Jacob Lurie</td>
<td>Monumental book: Higher topos theory: In its 940 pages Jacob Lurie generalizes the common concepts of category theory to higher categories and defines n-toposes, ∞-toposes, sheaves of n-types, ∞-sites, ∞-Yoneda lemma and proves Lurie characterization theorem for higher-dimensional toposes. Lurie's theory of higher toposes can be interpreted as giving a good theory of sheaves taking values in ∞-categories. Roughly an ∞-topos is an ∞-category which looks like the ∞-category of all homotopy types. In a topos mathematics can be done. In a higher topos not only mathematics can be done but also &quot;n-geometry&quot;, which is higher homotopy theory. The topos hypothesis is that the (n+1)-category nCat is a Grothendieck (n+1)-topos. Higher topos theory can also be used in a purely algebroid-geometric way to solve various moduli problems in this setting.</td>
</tr>
<tr>
<td>2006</td>
<td>Marni Dee Sheppeard</td>
<td>Quantum toposes</td>
</tr>
<tr>
<td>2007</td>
<td>Bernhard Keller–Thomas Hugh</td>
<td>d-cluster categories</td>
</tr>
<tr>
<td>2007</td>
<td>Dennis Gaitsgory–Jacob Lurie</td>
<td>Presents a derived version of the geometric Satake equivalence and formulates a geometric Langlands duality for quantum groups.</td>
</tr>
<tr>
<td>2008</td>
<td>Ieke Moerdijk–Clemens Berger</td>
<td>Extends and improved the definition of Reedy category to become invariant under equivalence of categories.</td>
</tr>
<tr>
<td>2008</td>
<td>Michael J. Hopkins–Jacob Lurie</td>
<td>Sketch of proof of Baez-Dolan tangle hypothesis and Baez-Dolan cobordism hypothesis which classify extended TQFT in all dimensions.</td>
</tr>
</tbody>
</table>
Timeline of Gulf War (1990–1991)

1990

- 28–30 May: Iraqi president Saddam Hussein says that oil overproduction by Kuwait and United Arab Emirates was an "economic warfare" against Iraq.
- 28 May: President of Iraq Saddam Hussein and Emir of Kuwait Jaber Al-Ahmad Al-Sabah meet at the Arab League Summit in Baghdad.
- 15 July: Iraq accuses Kuwait of stealing oil from the Rumaila oil field, an Iraqi oil field near the Iraqi-Kuwaiti border, and threatens military action in response.
- 22 July: Iraq begins deploying troops to the Iraqi-Kuwaiti border, creating a massive military buildup.
- 24 July: President of Egypt Hosni Mubarak travels to Baghdad to meet with Saddam Hussein and discuss the dispute between Kuwait and Iraq.
- 2 August: About 100,000 Iraqi troops invade Kuwait.
- 2 August: Battle of Dasman Palace. Emir Jaber Al-Ahmad Al-Sabah flees to Saudi Arabia with his family and ministers.
- 2 August: United Nations Security Council (UNSC) Resolution 660 condemns the Iraqi invasion of Kuwait. Yemen is the only Arab country that does not take part in the vote in the UNSC.
- 3 August: President of the United States George H.W. Bush announces that U.S. Navy ships have been deployed to the Persian Gulf.
- 4 August: Alaa Hussein Ali is appointed Prime Minister of the Provisional Government of Free Kuwait and Ali Hassan al-Majid is appointed Governor of the Kuwait Governorate, which is declared the 19th Governorate of Iraq.
- 5 August: Emir Jaber Al-Ahmad Al-Sabah forms the Government in exile in Ta'if, Saudi Arabia.
- 6 August: United Nations Security Council Resolution 661 implements international sanctions on Iraq. Yemen doesn't take part in the vote in the UNSC.
- 6 August: United States Secretary of Defense Dick Cheney meets King of Saudi Arabia Fahd in Riyadh to discuss sending U.S. military troops to defend Saudi Arabia in case of an Iraqi invasion.
- 7 August: 15,000 U.S. troops, 32 destroyers and 100 helicopters and fighter planes arrive in Saudi Arabia.
- 8 August: Operation Desert Shield is launched by the United States.
- 9 August: Iraq closes all its land borders.
• 10 August: Arab League Emergency summit takes place in Cairo. The majority of Arab countries condemn the invasion and call on Iraq to withdraw its troops from Kuwait and reinstate Jaber Al-Ahmad Al-Sabah as Emir of Kuwait. Only Libya and the Palestine Liberation Organization support the Iraqi invasion.

• 10 August: Arab League Cairo summit votes, by a very small margin, to send Egyptian, Syrian and Moroccan military troops to the Gulf region to support Kuwait.

• 12 August: Naval blockade of Iraq begins.

• 13 August: Indian Government starts to airlift Indian nationals from Kuwait via Amman to Mumbai. About 175,000 Indian nationals are evacuated from Kuwait through 20 October.

• 15 August: Iran and Iraq re-establish diplomatic relations for the first time since the Iran–Iraq War.

• 16 August: Secretary Dick Cheney orders U.S. naval ships to stop all cargo and tankers leaving and entering Iraq and Kuwait.


• 19 August: United Arab Emirates allows foreign troops to enter its territory.

• 20 August: Hundred of thousands of Pakistani, Egyptian, Palestinian, and Filipino guest workers flee Kuwait to Jordan.

• 20 August: 82 British nationals are taken hostage in Kuwait.


• 26 August: Iraq sieges foreign embassies in Kuwait City.

• 28 August: Kuwait formally annexed by Iraq.

• 29 August: United Nations Secretary-General Javier Pérez de Cuéllar travels to Baghdad to meet Foreign Minister of Iraq Tariq Aziz.

• 1 September: Iraq allows 700 Westerners, held hostage since the invasion, to leave Iraq.

• 2 September: Secretary-General Javier Pérez de Cuéllar returns from Baghdad without any agreement with the Government of Iraq.

• 9 September: President of the United States George H.W. Bush and President of the Soviet Union Mikhail Gorbachev meet in Helsinki to discuss the Iraqi invasion. In a press conference, the presidents demand Iraq leave Kuwait under the UNSC Resolutions of 660, 661, 662, 664 and 665.

• 11 September: President George H.W. Bush in an address to a joint session of Congress issues conditions that Iraq must withdraw from Kuwait completely.

• 14 September: United Kingdom and France announce the deployment of troops to Saudi Arabia.


• 17 October: 200,000 American, 15,000 British and 11,000 French troops are stationed in the Gulf region.
8 November: U.S sends more troops to the Gulf region. About 100,000 troops arrive to support the existing 220,000 troops in the region.

19 November: Iraq sends about 200,000 more troops to Kuwait.

29 November: The U.N. Security Council passes Resolution 678, requiring Iraq to withdraw from Kuwait before January 15, 1991, or face military action.

29 November: President George H.W. Bush invites Foreign Minister of Iraq Tariq Aziz to meet in Washington D.C.

6 December: Iraq releases 3,000 foreign hostages from Kuwait and Iraq.

10 December: Iraq releases British hostages.

1991

9 January: United States Secretary of State James Baker meets Foreign Minister of Iraq Tariq Aziz at the Geneva Conference in Hotel InterContinental. No solution is reached.

January 12: U.S. Congress passed a joint resolution authorizing the use of military force in Iraq and Kuwait. The votes were 52-47 in the U.S. Senate and 250-183 in the House of Representatives. These were the closest margins in authorizing force by the U.S. Congress since the War of 1812.

12 January: United Nations Secretary-General Javier Pérez de Cuéllar meets Saddam Hussein in Baghdad but does not reach an agreement with the Government of Iraq to withdraw from Kuwait.

12 January: Soviet special envoy Yevgeny Primakov meets with Saddam Hussein in Baghdad to discuss the possible Coalition invasion of Kuwait.

15 January: Saddam Hussein announces that Iraq will consider withdrawing its troops from Kuwait under some conditions.

15 January: 580,000 Coalition troops are stationed in the Gulf region, opposing 540,000 Iraqi troops.

15 January: First U.S. government statement relating to Operation Desert Storm is made.

15 January: Iraq ignores all UN resolutions.

16 January: Coalition forces led by the U.S. start deploying to Kuwait via the Persian Gulf and the Saudi Arabian border, triggering the first official infantry combat.


17 January: Foreign Minister of Iraq Tariq Aziz meets President of the Soviet Union Mikhail Gorbachev in Moscow where they discuss the Soviet peace plan.

17 January: Operation Desert Storm is launched and the first air attacks are launched on Iraq and Kuwait.
18 January, 01:00 GMT: Iraq fires 12 Scud missiles at the Israeli cities of Haifa and Tel Aviv, slightly injuring 12 people. The United States tells Israel to not retaliate, out of fear that it will escalate the war and trigger the collapse of the Arab Coalition. The U.S. deploys Patriot missiles to Israel and Saudi Arabia.

21 January: Foreign Minister of Iraq Tariq Aziz accepts the Soviet peace plan. President Bush refuses the peace plan as unrealistic for the coalition.

22 January: Iraq burns Kuwaiti oil fields. About 600 oil fields are on fire.

24 January: Iraq continues to burn Kuwaiti oil fields and dumps the oil into the Persian Gulf.

24 January: Coalition forces capture the small Kuwaiti island of Qaruh.


29 January: United States and the Soviet Union offer a ceasefire to Iraq if it withdraws all its troops from Kuwait.

29 January: Iraqi forces invade the town of Khafji in Saudi Arabia. Iraqi forces are quickly engaged by Saudi Arabian and Qatari troops with help from the U.S. Marines.

30 January: Coalition starts its first land operations in Kuwait and Southern Iraq.

1 February: Iraqi forces are driven out of Saudi Arabia.

22 February: U.S. President George H. W. Bush issues a 24-hour ultimatum: Iraq must withdraw from Kuwait to avoid starting a ground war.

24 February: U.S.-led Coalition forces invade Iraq and Kuwait at around 4 a.m. Baghdad time. Special Air Service was the first to enter Iraqi territory.

25 February: 20,000 Iraqi troops surrender to the coalition. By the end of February, about 100,000 Iraqi troops will have surrendered.

25 February: Iraq launches Scud missile attacks on Dhahran in Saudi Arabia which kills 28 American troops and injures 98 civilians.

26 February: President of Iraq Saddam Hussein announces that Iraq will withdraw from Kuwait totally and accept the UN resolution. Saddam still does not renounce Iraqi claims over Kuwait.

26 February: About 10,000 retreating Iraqi troops are killed when coalition aircraft bombed their stolen civilian and military vehicles. This becomes known as the Highway of Death.

26 February: Iraqi troops flee from Kuwait City.

27 February: U.S. Marines and Saudi Arabian troops enter Kuwait City.

27 February: 101st Airborne Division is less than 250 km from Baghdad over Highway 8.

27 February: President Bush announces that the Liberation of Kuwait has started and the cessation of hostilities will end that day at 04:00 GMT.
27 February: Coalition announces they have destroyed almost half of the all Iraqi divisions and 500,000 Iraqi troops has been taken as POWs.

28 February: President of the United States George H.W. Bush announces the ceasefire, declaring that Kuwait is free and the Iraqi Army is defeated.

28 February: Iraq announces that it will accept all UN resolutions.

1 March: Half of Saddam Hussein's Republican Guard tanks escape.

1 March: A cease-fire plan is negotiated in Safwan, Iraq.

3 March: Iraq accepts the terms of a ceasefire from the U.N. Security Council.

6 March: Shia rebellion starts in Basra.

13 March: United States Secretary of State James Baker meets President of Syria Hafez Al-Assad in Damascus to discuss future Middle East issues.

14 March: Anti-Saddam rebellions continue in Iraq.

26 March: White House announces that Iraqi helicopters will not be shot down.

30 March: First Arab League summit since the Kuwaiti invasion starts in Cairo. An Iraqi delegation takes part in the summit.

3 April: Iraqi army massacres Kurds in Northern Iraq.

11 April: Armistice is signed between the Coalition and Iraqi Army.

7 April: Kuwaiti Emir promises elections in Kuwait in 1992 and returns to Kuwait 7 days later.

17 April: U.S. troops enter Northern Iraq from Turkey to protect Kurdish refugees.

21 April: General Schwarzkopf returns to the U.S.

May: Bush extends pre-war economic sanctions "until Saddam Hussein is out of power".

15 June: 29 people are accused of co-operating with the Iraqi forces, and are executed in Kuwait.

16 August: UN repeals some Iraqi sanctions; Iraq is allowed to produce oil, limited to about USD$1.6 billion per barrel.

30 August: Kuwaiti Air Force attacks Iraqi destroyer in the Persian Gulf.

7 November: The final Kuwaiti oil fire is extinguished.

**Aftermath**

**1992**

- 26: August: No-fly zone is established in Southern Iraq.
1993

- 26 June: United States bombs Iraq.

1994

- 10 November: Iraq recognizes Kuwaiti independence and acknowledge their shared border.

1995

- 14 April: United Nations Security Council approves the oil for food program to Iraq.

1996

- 3 September: United States bombs Iraq and extends the No-fly zone in Southern Iraq.

1998

- 31 October: Iraq ends its co-operation with the United Nations Special Commission.

**Timeline of sexual orientation and medicine**

19th century

1886

- Dr. Richard Freiherr von Krafft-Ebing, a German psychiatrist, published a study of sexual perversity.

20th century

1948

- Sexual Behavior in the Human Male, the first "Kinsey Report", was published by Dr. Alfred Kinsey.

1953

- Sexual Behavior in the Human Female, the second "Kinsey Report", was published by Dr. Alfred Kinsey.
1957

- The Society for the Scientific Study of Sexuality was founded to encourage the rigorous systematic study of sexuality.

1973

- The American Psychiatric Association voted to remove homosexuality from the Diagnostic and Statistical Manual of Mental Disorders (DSM).

1977

- The Bay Area Physicians for Human Rights was founded in San Francisco as a support group for gay and lesbian medical students, residents, and other health care providers. The group claims to be the first LGBT medical society in the US.

1981

- The Gay and Lesbian Medical Association was founded in 1981 as the American Association of Physicians for Human Rights.
- The first cases of Gay related immunodeficiency, now known as AIDS, were first reported 5 June 1981, when the US Centers for Disease Control and Prevention recorded a cluster of *Pneumocystis carinii* pneumonia in five homosexual men in Los Angeles.

1987

- The diagnosis of Ego-dystonic sexual orientation was dropped from the DSM.

1990

- The World Health Organization replaced its categorization of homosexuality as a mental illness with the diagnosis of ego-dystonic homosexuality.

1991

- The American Psychoanalytic Association issued a statement allowing training of gay psychoanalysts.

1992
• The American Psychoanalytic Association prohibited discrimination against gay people when selecting teaching faculty.

1993

• Dr. Dean Hamer published a paper suggesting a genetic component to sexual orientation.

1995

• Saquinavir, the first protease inhibitor was approved for public use by the FDA. HAART radically changes the prognosis of HIV/AIDS.

1996

• The US Department of Defense included homosexuality in a list of "mental disorders," in a document known as "directive 1332.38: physical disability evaluation."

21st century

2002

• The United States Department of Health and Human Services published Healthy People 2010, with the goals of increasing the quality and years of healthy life and eliminating health disparities in America. It identified sexual orientation as one of 6 demographic factors contributing to health disparities.

America’s gay and lesbian population comprises a diverse community with disparate health concerns. Major health issues for gay men are HIV/AIDS and other sexually transmitted diseases, substance abuse, depression, and suicide. Gay male adolescents are two to three times more likely than their peers to attempt suicide. Some evidence suggests lesbians have higher rates of smoking, overweight, alcohol abuse, and stress than heterosexual women. The issues surrounding personal, family, and social acceptance of sexual orientation can place a significant burden on mental health and personal safety.

— Healthy People 2010

2004

• New York Medical College revoked the charter of its LGBT medical student group after the applies to change its name from Student Help Organization to Lesbian, Gay, Bisexual & Transgender People in Medicine. School officials claimed “the organization and its leader would advocate and promote activities
inconsistent with the values of NYMC.” In an interview with the Westchester Journal News, then AMA president Dr. John Nelson said that as a private institution the college has the right to set and enforce its own policies. The AMA organization did not support the ban, and the organization released a statement claiming the president's views were not representative of AMA policy.

If you own a business or if you have a private entity, and there are rules for membership there, you have to follow the rules or you can't be a member. For example, if you come to Brigham Young University, where my children happen to go to school, there are certain things you do not do, among which is, you do not drink Coca-Cola on campus because that's against the rules. ...

— Dr. John Nelson, president AMA


These [LGBT] adolescents may experience profound isolation and fear of discovery, which interferes with achieving developmental tasks of adolescence related to self-esteem, identity, and intimacy. Nonheterosexual youth often are subjected to harassment and violence; 45% of gay men and 20% of lesbians surveyed were victims of verbal and physical assaults in secondary school specifically because of their sexual orientation. Nonheterosexual youth are at higher risk of dropping out of school, being kicked out of their homes, and turning to life on the streets for survival. Some of these youth engage in substance use, and they are more likely than heterosexual peers to start using tobacco, alcohol, and illegal drugs at an earlier age. Youth in high school who identify themselves as gay, lesbian, or bisexual; engage in sexual activity with persons of the same sex; or report same-sex romantic attractions or relationships are more likely to attempt suicide, be victimized, and abuse substances. . . . School-based studies have found that these adolescents, compared with heterosexual peers, are 2 to 7 times more likely to attempt suicide [and] are 2 to 4 times more likely to be threatened with a weapon at school.

— American Academy of Pediatrics

2005

- American Medical Association president Edward Hill, MD became the first AMA president to address the Gay and Lesbian Medical Association in a speech entitled "Understanding, Advocacy, Leadership: The AMA Perspective on LGBT Health."

I know that GLMA members and LGBT physicians have been treated unfairly by the AMA in the past. There is simply no excuse for discriminatory actions or exclusions based on sexual orientation or gender identity -- none.

First, GLMA has opened [the AMA's] eyes to the diverse needs of LGBT patients, and second -- and just as
important -- GLMA has told patients that they have the right to expect a health care system filled with openness, fairness and equality."

— Dr. Edward Hill, MD, president American Medical Association

2006

- Touro University, a medical school in California, revoked the charter of its LGBT student organization. After an outcry of protest from various groups, the school restored the group and school officials apologized.

2007

- The American Medical Student Association membership voted to create an action committee on LGBT health issues and elected Brian Hurley to the office of national vice-president, the first LGBT person to hold the office.
- The US Food and Drug Administration re-affirmed its policy prohibiting men who have sex with men (MSM) from donating blood despite recommendations from the American Red Cross, and the American Association of Blood Banks.
- James Holsinger was nominated by President George W. Bush to be US surgeon general. Because of Holsinger's alleged support of the ex-gay movement, his nomination drew sharp criticism from groups like the Gay and Lesbian Medical Association and the Human Rights Campaign.

2013

- The National Library of Medicine created the medical subject heading "Homophobia". The new medical topic was meant to catalog scientific reporting on "Differential treatment or unequal access to opportunities or services based on perceived homosexual preference or orientation."

2019

- The American Psychoanalytic Association apologized for having treated homosexuality as a mental illness.

**Timeline of Solar System exploration**
### 1950s

<table>
<thead>
<tr>
<th>Mission name</th>
<th>Launch date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sputnik 1</td>
<td>4 October 1957</td>
<td>First Earth orbiter</td>
</tr>
<tr>
<td>Sputnik 2</td>
<td>3 November 1957</td>
<td>Earth orbiter, <strong>first animal in orbit</strong>, a dog named Laika</td>
</tr>
<tr>
<td>Explorer 1</td>
<td>1 February 1958</td>
<td>Earth orbiter; discovered Van Allen radiation belts</td>
</tr>
<tr>
<td>Vanguard 1</td>
<td>17 March 1958</td>
<td>Earth orbiter; oldest spacecraft still in Earth orbit</td>
</tr>
<tr>
<td>Luna 1</td>
<td>2 January 1959</td>
<td><strong>First lunar flyby</strong> (attempted lunar impact?); first artificial satellite in heliocentric orbit.</td>
</tr>
<tr>
<td>Pioneer 4</td>
<td>3 March 1959</td>
<td>Lunar flyby</td>
</tr>
<tr>
<td>Luna 2</td>
<td>12 September 1959</td>
<td><strong>First lunar impact, First artificial object on Moon</strong></td>
</tr>
<tr>
<td>Luna 3</td>
<td>4 October 1959</td>
<td>Lunar flyby; First images of another celestial body taken from space, most notably, <strong>the far side of Moon</strong></td>
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### 1960s

<table>
<thead>
<tr>
<th>Mission name</th>
<th>Launch date</th>
<th>Description</th>
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<tbody>
<tr>
<td>Pioneer 5</td>
<td>11 March 1960</td>
<td>Interplanetary space investigations</td>
</tr>
<tr>
<td>Venera 1</td>
<td>12 February 1961</td>
<td><strong>First probe to another planet</strong>; Venus flyby (contact lost before flyby)</td>
</tr>
<tr>
<td>Vostok 1</td>
<td>12 April 1961</td>
<td><strong>First crewed Earth orbiter</strong> (Yuri Gagarin)</td>
</tr>
<tr>
<td>Ranger 1</td>
<td>23 August 1961</td>
<td>Attempted lunar test flight (failed to leave Earth orbit)</td>
</tr>
<tr>
<td>Ranger 2</td>
<td>18 November 1961</td>
<td>Attempted lunar test flight (failed to leave Earth orbit)</td>
</tr>
<tr>
<td>Ranger 3</td>
<td>26 January 1962</td>
<td>Attempted lunar impact (missed Moon)</td>
</tr>
<tr>
<td>Ranger 4</td>
<td>23 April 1962</td>
<td>Lunar impact (but unintentionally became the first spacecraft to hit the lunar farside and returned no data)</td>
</tr>
<tr>
<td>Mariner 2</td>
<td>27 August 1962</td>
<td><strong>First successful planetary encounter, First successful Venus flyby</strong></td>
</tr>
<tr>
<td>Ranger 5</td>
<td>18 October 1962</td>
<td>Attempted lunar impact (missed Moon)</td>
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<tr>
<td>Mars 1</td>
<td>1 November 1962</td>
<td><strong>First probe to Mars</strong>: flyby (contact lost)</td>
</tr>
<tr>
<td>Luna 4</td>
<td>2 April 1963</td>
<td>Attempted lunar lander (missed Moon)</td>
</tr>
<tr>
<td>Cosmos 21</td>
<td>11 November 1962</td>
<td>Attempted Venera test flight?</td>
</tr>
<tr>
<td>1963</td>
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<tr>
<td>Ranger 6</td>
<td>30 January 1964</td>
<td>Lunar impact (cameras failed)</td>
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<tr>
<td>Zond 1</td>
<td>2 April 1964</td>
<td>Venus flyby (contact lost)</td>
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<tr>
<td>Ranger 7</td>
<td>28 July 1964</td>
<td>Lunar impact</td>
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<tr>
<td>Voskhod 1</td>
<td>12 October 1964</td>
<td><strong>First orbiter with multimember crew</strong></td>
</tr>
<tr>
<td>Mariner 3</td>
<td>5 November 1964</td>
<td>Attempted Mars flyby (failed to attain correct trajectory)</td>
</tr>
<tr>
<td>Mariner 4</td>
<td>28 November 1964</td>
<td><strong>First successful Mars flyby</strong></td>
</tr>
<tr>
<td>Zond 2</td>
<td>30 November 1964</td>
<td>Mars flyby (contact lost)</td>
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<tr>
<td>Ranger 8</td>
<td>17 February 1965</td>
<td>Lunar impact</td>
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<tr>
<td>Voskhod 2</td>
<td>18 March 1965</td>
<td><strong>First space walk</strong> by Alexei Leonov</td>
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<td>Ranger 9</td>
<td>21 March 1965</td>
<td>Lunar impact</td>
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<tr>
<td>Lincoln Calibration Sphere 1</td>
<td>6 May 1965</td>
<td><strong>Oldest spacecraft still in use</strong></td>
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<td>Luna 5</td>
<td>9 May 1965</td>
<td>Lunar impact (attempted soft landing)</td>
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<td>8 June 1965</td>
<td>Attempted lunar lander (missed Moon)</td>
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<tr>
<td>Zond 3</td>
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<td>Lunar flyby</td>
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<tr>
<td>Luna 7</td>
<td>4 October 1965</td>
<td>Lunar impact (attempted soft landing)</td>
</tr>
<tr>
<td>Venera 2</td>
<td>12 November 1965</td>
<td>Venus flyby (contact lost)</td>
</tr>
<tr>
<td>Venera 3</td>
<td>16 November 1965</td>
<td>Venus lander (contact lost) – <strong>First spacecraft to reach another planet’s surface, First Venus impact</strong></td>
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<tr>
<td>Luna 8</td>
<td>3 December 1965</td>
<td>Lunar impact (attempted soft landing?)</td>
</tr>
<tr>
<td>Pioneer 6</td>
<td>16 December 1965</td>
<td>&quot;Space weather&quot; observations</td>
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<tr>
<td>Luna 9</td>
<td>31 January 1966</td>
<td><strong>First lunar lander</strong></td>
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<tr>
<td>AS-201</td>
<td>26 February 1966</td>
<td>Lunar programme test flight</td>
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<td>Luna 10</td>
<td>31 March 1966</td>
<td><strong>First lunar orbiter</strong></td>
</tr>
<tr>
<td>Mission</td>
<td>Launch Date</td>
<td>Mission</td>
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<tr>
<td>Surveyor 1</td>
<td>30 May 1966</td>
<td>Lunar lander</td>
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<tr>
<td>Explorer 33</td>
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<td>Attempted lunar orbiter (failed to attain lunar orbit)</td>
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<tr>
<td>Lunar Orbiter 1</td>
<td>10 August 1966</td>
<td>Lunar orbiter</td>
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<tr>
<td>Pioneer 7</td>
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<td>&quot;Space weather&quot; observations</td>
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<tr>
<td>Luna 11</td>
<td>24 August 1966</td>
<td>Lunar orbiter</td>
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<tr>
<td>Surveyor 2</td>
<td>20 September 1966</td>
<td>Attempted lunar lander (crashed into Moon)</td>
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<td>Luna 12</td>
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<td>Lunar orbiter</td>
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<tr>
<td>Lunar Orbiter 2</td>
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<td>Lunar orbiter</td>
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<td>Luna 13</td>
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<td>Lunar Orbiter 3</td>
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<td>Lunar orbiter</td>
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<td>Surveyor 3</td>
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<td>Lunar lander</td>
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<td>Lunar Orbiter 4</td>
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<td>Lunar orbiter</td>
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<tr>
<td>Venera 4</td>
<td>12 June 1967</td>
<td>First Venus atmospheric probe</td>
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<tr>
<td>Mariner 5</td>
<td>14 June 1967</td>
<td>Venus flyby</td>
</tr>
<tr>
<td>Surveyor 4</td>
<td>14 July 1967</td>
<td>Attempted lunar lander (crashed into Moon)</td>
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<td>Explorer 35 (IMP-E)</td>
<td>19 July 1967</td>
<td>Lunar orbiter</td>
</tr>
<tr>
<td>Lunar Orbiter 5</td>
<td>1 August 1967</td>
<td>Lunar orbiter</td>
</tr>
<tr>
<td>Surveyor 5</td>
<td>8 September 1967</td>
<td>Lunar lander</td>
</tr>
<tr>
<td>Surveyor 6</td>
<td>7 November 1967</td>
<td>Lunar lander, first lift-off from an extraterrestrial body</td>
</tr>
<tr>
<td>Apollo 4</td>
<td>9 November 1967</td>
<td>Lunar programme test flight in Earth orbit (uncrewed)</td>
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<tr>
<td>Pioneer 8</td>
<td>13 December 1967</td>
<td>&quot;Space weather&quot; observations</td>
</tr>
<tr>
<td>Surveyor 7</td>
<td>7 January 1968</td>
<td>Lunar lander</td>
</tr>
<tr>
<td>Apollo 5</td>
<td>22 January 1968</td>
<td>Lunar programme test flight in Earth orbit (uncrewed)</td>
</tr>
<tr>
<td>Zond 4</td>
<td>2 March 1968</td>
<td>Lunar programme test flight out of Earth orbit (uncrewed)</td>
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<tr>
<td>Luna 14</td>
<td>7 April 1968</td>
<td>Lunar orbiter</td>
</tr>
<tr>
<td>Zond 5</td>
<td>14 September 1968</td>
<td>First lunar flyby and return to Earth, first life forms to circle the</td>
</tr>
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1968

<table>
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<th>Mission</th>
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<tr>
<td>Apollo 7</td>
<td>11 October 1968</td>
<td>Lunar programme test flight in Earth orbit (crewed)</td>
</tr>
<tr>
<td>Pioneer 9</td>
<td>8 November 1968</td>
<td>&quot;Space weather&quot; observations</td>
</tr>
<tr>
<td>Zond 6</td>
<td>10 November 1968</td>
<td>Lunar flyby and return to Earth</td>
</tr>
<tr>
<td>Apollo 8</td>
<td>21 December 1968</td>
<td>First crewed lunar orbiter</td>
</tr>
<tr>
<td>Venera 5</td>
<td>5 January 1969</td>
<td>Venus atmospheric probe</td>
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<tr>
<td>Venera 6</td>
<td>10 January 1969</td>
<td>Venus atmospheric probe</td>
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<tr>
<td>Mariner 6</td>
<td>25 February 1969</td>
<td>Mars flyby</td>
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<tr>
<td>Apollo 9</td>
<td>3 March 1969</td>
<td>Crewed lunar lander (LEM) flight test in Earth orbit</td>
</tr>
<tr>
<td>Mariner 7</td>
<td>27 March 1969</td>
<td>Mars flyby</td>
</tr>
<tr>
<td>Apollo 10</td>
<td>18 May 1969</td>
<td>Crewed lunar orbiter</td>
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<tr>
<td>Luna 15</td>
<td>13 July 1969</td>
<td>Second attempted lunar sample return</td>
</tr>
<tr>
<td>Apollo 11</td>
<td>16 July 1969</td>
<td>First crewed lunar landing and first successful sample return mission</td>
</tr>
<tr>
<td>Zond 7</td>
<td>7 August 1969</td>
<td>Lunar flyby and return to Earth</td>
</tr>
<tr>
<td>Apollo 12</td>
<td>14 November 1969</td>
<td>Crewed lunar landing</td>
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1970s

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<tr>
<th>Mission name</th>
<th>Launch date</th>
<th>Description</th>
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<tbody>
<tr>
<td>Apollo 13</td>
<td>11 April 1970</td>
<td>Crewed lunar flyby and return to Earth (crewed lunar landing aborted) Farthest from Earth a human has gone (401,056 km)</td>
</tr>
<tr>
<td>Venera 7</td>
<td>17 August 1970</td>
<td>First Venus lander and the first spacecraft to land on another planet</td>
</tr>
<tr>
<td>Luna 16</td>
<td>12 September 1970</td>
<td>First robotic lunar sample return</td>
</tr>
<tr>
<td>Zond 8</td>
<td>20 October</td>
<td>Lunar flyby and return to Earth</td>
</tr>
<tr>
<td>Mission</td>
<td>Date</td>
<td>Event</td>
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<tr>
<td>Luna 17/Lunokhod 1</td>
<td>10 November 1970</td>
<td><strong>First remote controlled rover</strong></td>
</tr>
<tr>
<td>Apollo 14</td>
<td>31 January 1971</td>
<td>Crewed lunar landing</td>
</tr>
<tr>
<td>Salyut 1</td>
<td>19 April 1971</td>
<td><strong>First space station</strong></td>
</tr>
<tr>
<td>Mars 2</td>
<td>19 May 1971</td>
<td><strong>First Mars impact</strong>, Mars orbiter and attempted lander; <strong>First rover on Martian surface</strong> (Prop-M unsuccessful)</td>
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<tr>
<td>Mars 3</td>
<td>28 May 1971</td>
<td>Mars orbiter, <strong>First Mars lander</strong> (lost contact after 14.5s)</td>
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<tr>
<td>Mariner 9</td>
<td>30 May 1971</td>
<td><strong>First Mars orbiter</strong></td>
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<tr>
<td>Apollo 15</td>
<td>26 July 1971</td>
<td>Crewed lunar landing: <strong>First crewed lunar rover</strong></td>
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<td>Luna 18</td>
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<td>Luna 19</td>
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<td>Lunar orbiter</td>
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<td>Luna 20</td>
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<td>Lunar robotic sample return</td>
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<td>Pioneer 10</td>
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<td><strong>First Jupiter flyby</strong></td>
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<td>Venera 8</td>
<td>27 March 1972</td>
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<tr>
<td>Apollo 16</td>
<td>16 April 1972</td>
<td>Crewed lunar landing</td>
</tr>
<tr>
<td>Apollo 17</td>
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<td>Last crewed lunar landing</td>
</tr>
<tr>
<td>Luna 21/Lunokhod 2</td>
<td>8 January 1973</td>
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<tr>
<td>Pioneer 11</td>
<td>5 April 1973</td>
<td>Jupiter flyby and <strong>First Saturn flyby</strong></td>
</tr>
<tr>
<td>Explorer 49 (RAE-B)</td>
<td>10 June 1973</td>
<td>Lunar orbiter/radio astronomy</td>
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<tr>
<td>Mars 4</td>
<td>21 July 1973</td>
<td>Mars flyby (attempted Mars orbiter)</td>
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<td>Mission</td>
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<tr>
<td>Mars 5</td>
<td>25 July 1973</td>
<td>Mars orbiter</td>
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<tr>
<td>Mars 6</td>
<td>5 August 1973</td>
<td>Mars flyby and attempted lander (failed due to damage on Mars landing)</td>
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<tr>
<td>Mars 7</td>
<td>9 August 1973</td>
<td>Mars flyby and attempted lander (missed Mars)</td>
</tr>
<tr>
<td>Mariner 10</td>
<td>3 November 1973</td>
<td>Lunar and Venus flybys in addition to the <strong>First Mercury flyby</strong></td>
</tr>
<tr>
<td>Luna 22</td>
<td>29 May 1974</td>
<td>Lunar orbiter</td>
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<tr>
<td>Luna 23</td>
<td>28 October 1974</td>
<td>Attempted lunar sample return (failed due to damage on lunar landing)</td>
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<tr>
<td>Helios-A</td>
<td>10 December 1974</td>
<td>Solar observations</td>
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<tr>
<td>Venera 9</td>
<td>8 June 1975</td>
<td><strong>First Venus orbiter</strong> and lander; <strong>First images from surface of Venus</strong></td>
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<tr>
<td>Venera 10</td>
<td>14 June 1975</td>
<td>Venus orbiter and lander</td>
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<tr>
<td><em>Viking 1</em></td>
<td>20 August 1975</td>
<td>Mars orbiter and lander; <strong>First clear pictures from Martian surface</strong></td>
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<td><em>Viking 2</em></td>
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<td>Mars orbiter and lander</td>
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<tr>
<td>Helios-B</td>
<td>15 January 1976</td>
<td>Solar observations</td>
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<td>Luna 24</td>
<td>9 August 1976</td>
<td>Lunar robotic sample return</td>
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<tr>
<td><em>Voyager 2</em></td>
<td>20 August 1977</td>
<td>Jupiter/Saturn/**first Uranus/**first Neptune flyby</td>
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<td><em>Voyager 1</em></td>
<td>5 September 1977</td>
<td>Jupiter/Saturn flyby, <strong>first to exit the heliosphere</strong></td>
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<tr>
<td><em>Pioneer Venus 1</em></td>
<td>20 May 1978</td>
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<tr>
<td><em>Pioneer Venus 2</em></td>
<td>8 August 1978</td>
<td>Venus atmospheric probes</td>
</tr>
<tr>
<td>ISEE-3</td>
<td>12 August 1978</td>
<td>Solar wind investigations; later redesignated International Cometary Explorer and performed Comet Giacobini-Zinner and Comet Halley flybys – <strong>First comet flyby</strong></td>
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<td>Venera 11</td>
<td>9 September</td>
<td>Venus flyby and lander</td>
</tr>
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<td>Mission name</td>
<td>Launch date</td>
<td>Description</td>
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<tr>
<td>Venera 12</td>
<td>14 September 1978</td>
<td>Venus flyby and lander</td>
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<tr>
<td>Venera 13</td>
<td>30 October 1981</td>
<td>Venus flyby and lander</td>
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<tr>
<td>Venera 14</td>
<td>4 November 1981</td>
<td>Venus flyby and lander</td>
</tr>
<tr>
<td>Venera 15</td>
<td>2 June 1983</td>
<td>Venus orbiter</td>
</tr>
<tr>
<td>Venera 16</td>
<td>7 June 1983</td>
<td>Venus orbiter</td>
</tr>
<tr>
<td>Vega 1</td>
<td>15 December 1984</td>
<td>Venus flyby, lander and <em>first balloon</em>; continued on to Comet Halley flyby</td>
</tr>
<tr>
<td>Vega 2</td>
<td>21 December 1984</td>
<td>Venus flyby, lander and balloon; continued on to Comet Halley flyby</td>
</tr>
<tr>
<td>Sakigake</td>
<td>8 January 1985</td>
<td>Comet Halley flyby</td>
</tr>
<tr>
<td>Giotto</td>
<td>2 July 1985</td>
<td>First close observation of comet (distance 596 kilometers), Comet Halley flyby</td>
</tr>
<tr>
<td>Suisei (Planet-A)</td>
<td>18 August 1985</td>
<td>Comet Halley flyby</td>
</tr>
<tr>
<td>Mir</td>
<td>19 February 1986</td>
<td>First modular space station (operational 1986–2000; final module added 1996)</td>
</tr>
<tr>
<td>Phobos 1</td>
<td>7 July 1988</td>
<td>Attempted Mars orbiter/Phobos landers (contact lost)</td>
</tr>
<tr>
<td>Phobos 2</td>
<td>12 July 1988</td>
<td>Mars orbiter/attempted Phobos landers (contact lost)</td>
</tr>
<tr>
<td>Magellan</td>
<td>4 May 1989</td>
<td>Venus orbiter</td>
</tr>
<tr>
<td>Galileo</td>
<td>18 October 1989</td>
<td>Venus flyby, <em>first Asteroid flyby</em> (Gaspra), <em>first Asteroid moon discovery</em> (Dactyl), <em>first Jupiter orbiter</em>, <em>first Jupiter atmospheric probe</em></td>
</tr>
<tr>
<td>Mission name</td>
<td>Launch date</td>
<td>Description</td>
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</tr>
<tr>
<td>Hiten (MUSES-A)</td>
<td>24 January 1990</td>
<td>Lunar flyby and orbiter</td>
</tr>
<tr>
<td>Hubble Space Telescope</td>
<td>24 April 1990</td>
<td>Orbital space telescope ( operational since 1990)</td>
</tr>
<tr>
<td>Ulysses</td>
<td>6 October 1990</td>
<td>Solar polar orbiter</td>
</tr>
<tr>
<td>Mars Observer</td>
<td>25 September 1992</td>
<td>Attempted Mars orbiter (contact lost)</td>
</tr>
<tr>
<td>Clementine</td>
<td>25 January 1994</td>
<td>Lunar orbiter/attempted asteroid flyby (contact lost)</td>
</tr>
<tr>
<td>WIND</td>
<td>1 November 1994</td>
<td>Solar wind observations</td>
</tr>
<tr>
<td>SOHO</td>
<td>2 December 1995</td>
<td>Solar observatory ( operational since 1996)</td>
</tr>
<tr>
<td>NEAR Shoemaker</td>
<td>17 February 1996</td>
<td>Eros orbiter, first near-Earth asteroid flyby, first asteroid orbit and first asteroid landing</td>
</tr>
<tr>
<td>Mars Global Surveyor</td>
<td>7 November 1996</td>
<td>Mars orbiter</td>
</tr>
<tr>
<td>Mars 96</td>
<td>16 November 1996</td>
<td>Attempted Mars orbiter/landers (failed to escape Earth orbit)</td>
</tr>
<tr>
<td>Mars Pathfinder</td>
<td>4 December 1996</td>
<td>Mars lander and first successful planetary rover</td>
</tr>
<tr>
<td>ACE</td>
<td>25 August 1997</td>
<td>Solar wind and &quot;space weather&quot; observations (operational since 1998)</td>
</tr>
<tr>
<td>Cassini–Huygens</td>
<td>15 October 1997</td>
<td>First Saturn orbiter and first outer planet lander</td>
</tr>
<tr>
<td>Lunar Prospector</td>
<td>7 January 1998</td>
<td>Lunar orbiter</td>
</tr>
<tr>
<td>Nozomi (Planet-B)</td>
<td>3 July 1998</td>
<td>Attempted Mars orbiter (failed to enter Mars orbit)</td>
</tr>
<tr>
<td>Deep Space 1 (DS1)</td>
<td>24 October 1998</td>
<td>Asteroid and comet flyby</td>
</tr>
<tr>
<td>ISS</td>
<td>20 November 1998</td>
<td>International space station</td>
</tr>
<tr>
<td>Mars Climate Orbiter</td>
<td>11 December 1998</td>
<td>Attempted Mars orbiter (orbit insertion failed; entered atmosphere and was destroyed)</td>
</tr>
<tr>
<td>Mars Polar Lander/Deep</td>
<td>3 January 1999</td>
<td>Attempted Mars lander/penetrators (contact lost)</td>
</tr>
</tbody>
</table>
Space 2 (DS2)
Stardust 7 February 1999 **First comet coma sample return** (returned 15 January 2006)

**2000s**

<table>
<thead>
<tr>
<th>Mission name</th>
<th>Launch date</th>
<th>Description</th>
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<tbody>
<tr>
<td>2001 Mars Odyssey</td>
<td>7 April 2001</td>
<td>Mars orbiter</td>
</tr>
<tr>
<td>Genesis</td>
<td>8 August 2001</td>
<td><strong>First solar wind sample return</strong></td>
</tr>
<tr>
<td>CONTOUR</td>
<td>3 July 2002</td>
<td>Attempted flyby of comet nuclei (Encke, Schwassmann-Wachmann-3, and optionally a third one; lost in space)</td>
</tr>
<tr>
<td>Hayabusa (MUSES-C)</td>
<td>9 May 2003</td>
<td>Asteroid lander and <strong>first sample return from asteroid</strong></td>
</tr>
<tr>
<td>Mars Express/Beagle 2</td>
<td>2 June 2003</td>
<td>Mars orbiter/attempted lander (lander failure)</td>
</tr>
<tr>
<td>Mars Exploration</td>
<td>10 June 2003</td>
<td>Mars rover</td>
</tr>
<tr>
<td>Rover Spirit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mars Exploration</td>
<td>8 July 2003</td>
<td>Mars rover</td>
</tr>
<tr>
<td>Rover Opportunity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMART-1</td>
<td>27 September 2003</td>
<td>Lunar orbiter</td>
</tr>
<tr>
<td>Rossetta/Philae</td>
<td>2 March 2004</td>
<td>Asteroid Steins and Lutetia flybys; <strong>first comet orbiter and lander</strong> (Landed in November 2014)</td>
</tr>
<tr>
<td>MESSENGER</td>
<td>3 August 2004</td>
<td><strong>First Mercury orbiter</strong> (Achieved orbit 18 March 2011)</td>
</tr>
<tr>
<td>Deep Impact</td>
<td>12 January 2005</td>
<td>Comet flyby and impact</td>
</tr>
<tr>
<td>Mars Reconnaissance</td>
<td>12 August 2005</td>
<td>Mars orbiter</td>
</tr>
<tr>
<td>Orbiter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Venus Express</td>
<td>9 November 2005</td>
<td>Venus polar orbiter</td>
</tr>
<tr>
<td>New Horizons</td>
<td>19 January 2006</td>
<td><strong>First Pluto/Charon flyby</strong> (on 14 July 2015); continued on to 486958 Arrokoth flyby (on 1 January 2019)</td>
</tr>
<tr>
<td>Hinode (Solar-B)</td>
<td>22 September 2006</td>
<td>Solar orbiter</td>
</tr>
<tr>
<td>STEREO</td>
<td>26 October 2006</td>
<td>Two spacecraft, solar orbiters</td>
</tr>
<tr>
<td>Mission name</td>
<td>Launch date</td>
<td>Description</td>
</tr>
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<td>---------------------------------</td>
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</tr>
<tr>
<td>Phoenix</td>
<td>4 August 2007</td>
<td>Mars polar lander (Mars landing on 25 May 2008)</td>
</tr>
<tr>
<td>SELENE (Kaguya)</td>
<td>14 September 2007</td>
<td>Lunar orbiters</td>
</tr>
<tr>
<td>Dawn</td>
<td>27 September 2007</td>
<td>Asteroid Ceres and Vesta orbiter (Entered orbit around Vesta on 16 July 2011 and around Ceres on 6 March 2015)</td>
</tr>
<tr>
<td>Chang'e 1</td>
<td>24 October 2007</td>
<td>Lunar orbiter</td>
</tr>
<tr>
<td>Chandrayaan-1</td>
<td>22 October 2008</td>
<td>Lunar orbiter and impactor; discovered water on the Moon</td>
</tr>
<tr>
<td>Herschel Space Observatory</td>
<td>14 May 2009</td>
<td>Infrared space telescope at Sun–Earth L₂ Lagrange point</td>
</tr>
<tr>
<td>Lunar Reconnaissance Orbiter/LCROSS</td>
<td>18 June 2009</td>
<td>Lunar polar orbiter and lunar impactor</td>
</tr>
<tr>
<td>WISE (NEOWISE)</td>
<td>14 December 2009</td>
<td>Infrared survey of celestial sky (WISE mission); later Near-Earth object survey (NEOWISE mission)</td>
</tr>
</tbody>
</table>

**2010s**

<table>
<thead>
<tr>
<th>Mission name</th>
<th>Launch date</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Dynamics Observatory</td>
<td>11 February 2010</td>
<td>Continuous solar monitoring</td>
</tr>
<tr>
<td>Akatsuki (Planet-C)</td>
<td>20 May 2010</td>
<td>Venus orbiter (orbit insertion failed in 2010 / successful orbit insertion on 7 December 2015)</td>
</tr>
<tr>
<td>PICARD</td>
<td>15 June 2010</td>
<td>Solar monitoring</td>
</tr>
<tr>
<td>Chang'e 2</td>
<td>1 October 2010</td>
<td>Lunar orbiter, Asteroid 4179 Toutatis flyby</td>
</tr>
<tr>
<td>Juno</td>
<td>5 August 2011</td>
<td>Jupiter orbiter</td>
</tr>
<tr>
<td>GRAIL</td>
<td>10 September 2011</td>
<td>Two spacecraft, Lunar orbiters</td>
</tr>
<tr>
<td>Fobos-Grunt and Yinghuo-1</td>
<td>8 November 2011</td>
<td>Attempted Phobos sample return and Mars orbiter, respectively; both failed to escape Earth orbit</td>
</tr>
<tr>
<td>Mars Science Laboratory (Curiosity Rover)</td>
<td>26 November 2011</td>
<td>Mars rover (landed 6 August 2012)</td>
</tr>
<tr>
<td>Van Allen Probes (RBSP)</td>
<td>30 August 2012</td>
<td>Earth Van Allen radiation belts study</td>
</tr>
<tr>
<td>Mission</td>
<td>Date</td>
<td>Description</td>
</tr>
<tr>
<td>---------</td>
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<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>IRIS</td>
<td>28 June 2013</td>
<td>Solar observations</td>
</tr>
<tr>
<td>LADEE</td>
<td>7 September 2013</td>
<td>Lunar orbiter</td>
</tr>
<tr>
<td>Hisaki</td>
<td>14 September 2013</td>
<td>Planetary atmosphere observatory</td>
</tr>
<tr>
<td>Mars Orbiter Mission (Mangalyaan)</td>
<td>5 November 2013</td>
<td>Mars orbiter</td>
</tr>
<tr>
<td>MAVEN</td>
<td>18 November 2013</td>
<td>Mars orbiter</td>
</tr>
<tr>
<td>Chang'e 3</td>
<td>1 December 2013</td>
<td>Lunar lander and rover (first lander since Soviet Luna 24 in 1976)</td>
</tr>
<tr>
<td>Chang'e 5-T1</td>
<td>23 October 2014</td>
<td>Circumlunar mission and Earth reentry; technology demonstration to prepare for Chang'e 5 mission</td>
</tr>
<tr>
<td>Hayabusa2 / MASCOT</td>
<td>3 December 2014</td>
<td>Asteroid lander and sample return (sample return scheduled for December 2020), <strong>first asteroid rover</strong></td>
</tr>
<tr>
<td>PROCYON</td>
<td>3 December 2014</td>
<td>Comet observer and attempted asteroid flyby (engine failure)</td>
</tr>
<tr>
<td>Exploration Flight Test 1</td>
<td>5 December 2014</td>
<td>Uncrewed Earth orbital test of Orion vehicle</td>
</tr>
<tr>
<td>DSCOVR</td>
<td>11 February 2015</td>
<td>Solar observation</td>
</tr>
<tr>
<td>ExoMars Trace Gas Orbiter and EDM lander</td>
<td>14 March 2016</td>
<td>Mars orbiter and attempted lander (lander failure)</td>
</tr>
<tr>
<td>OSIRIS-REx</td>
<td>8 September 2016</td>
<td>Asteroid sample return mission (sample return scheduled for September 2023)</td>
</tr>
<tr>
<td>InSight</td>
<td>5 May 2018</td>
<td>Mars lander</td>
</tr>
<tr>
<td>Queqiao</td>
<td>20 May 2018</td>
<td>Relay satellite for Chang'e 4 in Halo orbit around Earth–Moon L$_2$ Lagrange point</td>
</tr>
<tr>
<td>Parker Solar Probe</td>
<td>12 August 2018</td>
<td>Solar corona probe, closest solar approach (0.04 AU)</td>
</tr>
<tr>
<td>BepiColombo</td>
<td>19 October 2018</td>
<td>Two Mercury orbiters (orbit insertion planned in December 2025)</td>
</tr>
<tr>
<td>Chang'e 4</td>
<td>7 December 2018</td>
<td>Lunar lander and rover, <strong>first landing on the lunar far side</strong></td>
</tr>
<tr>
<td>Beresheet</td>
<td>22 February 2019</td>
<td>Attempted lunar lander (crashed into Moon)</td>
</tr>
</tbody>
</table>
Antiquity

- 3000 BC – Meteorology in India can be traced back to around 3000 BC, with writings such as the Upanishads, containing discussions about the processes of cloud formation and rain and the seasonal cycles caused by the movement of earth round the sun.
- 600 BC – Thales may qualify as the first Greek meteorologist. He reputedly issues the first seasonal crop forecast.
- 400 BC – There is some evidence that Democritus predicted changes in the weather, and that he used this ability to convince people that he could predict other future events.
- 400 BC – Hippocrates writes a treatise called *Airs, Waters and Places*, the earliest known work to include a discussion of weather. More generally, he wrote about common diseases that occur in particular locations, seasons, winds and air.
- 350 BC – The Greek philosopher Aristotle writes *Meteorology*, a work which represents the sum of knowledge of the time about earth sciences, including weather and climate. It is the first known work that attempts to treat a broad range of meteorological topics. For the first time, precipitation and the clouds from which precipitation falls are called meteors, which originate from the Greek word *meteōros*, meaning 'high in the sky'. From that word comes the modern term meteorology, the study of clouds and weather.

Although the term *meteorology* is used today to describe a subdiscipline of the atmospheric sciences, Aristotle's work is more general. Meteorologica is based on intuition and simple observation, but not on what is now considered the scientific method. In his own words:

*...all the affections we may call common to air and water, and the kinds and parts of the earth and the affections of its parts.*
The magazine *De Mundo* (attributed to Pseudo-Aristotle) notes:

Cloud is a vaporous mass, concentrated and producing water. Rain is produced from the compression of a closely condensed cloud, varying according to the pressure exerted on the cloud; when the pressure is slight it scatters gentle drops; when it is great it produces a more violent fall, and we call this a shower, being heavier than ordinary rain, and forming continuous masses of water falling over earth. Snow is produced by the breaking up of condensed clouds, the cleavage taking place before the change into water; it is the process of cleavage which causes its resemblance to foam and its intense whiteness, while the cause of its coldness is the congelation of the moisture in it before it is dispersed or rarefied. When snow is violent and falls heavily we call it a blizzard. Hail is produced when snow becomes densified and acquires impetus for a swifter fall from its close mass; the weight becomes greater and the fall more violent in proportion to the size of the broken fragments of cloud. Such then are the phenomena which occur as the result of moist exhalation.

One of the most impressive achievements in *Meteorology* is his description of what is now known as the hydrologic cycle:

Now the sun, moving as it does, sets up processes of change and becoming and decay, and by its agency the finest and sweetest water is every day carried up and is dissolved into vapour and rises to the upper region, where it is condensed again by the cold and so returns to the earth.

- Several years after Aristotle's book, his pupil Theophrastus puts together a book on weather forecasting called *The Book of Signs*. Various indicators such as solar and lunar halos formed by high clouds are presented as ways to forecast the weather. The combined works of Aristotle and Theophrastus have such authority they become the main influence in the study of clouds, weather and weather forecasting for nearly 2000 years.
- 250 BC – Archimedes studies the concepts of buoyancy and the hydrostatic principle. Positive buoyancy is necessary for the formation of convective clouds (cumulus, cumulus congestus and cumulonimbus).
- 25 AD – Pomponius Mela, a geographer for the Roman empire, formalizes the climatic zone system.
- c. 80 AD – In his *Lunheng* (論衡; Critical Essays), the Han dynasty Chinese philosopher Wang Chong (27–97 AD) dispels the Chinese myth of rain coming from the heavens, and states that rain is evaporated from water on the earth into the air and forms clouds, stating that clouds condense into rain and also form dew, and says when the clothes of people in high mountains are moistened, this is because of the air-suspended rain water. However, Wang Chong supports his theory by quoting a similar one of Gongyang Gao's, the latter's commentary on the *Spring and Autumn Annals*, the Gongyang Zhuan, compiled in the 2nd century.
BC, showing that the Chinese conception of rain evaporating and rising to form clouds goes back much farther than Wang Chong. Wang Chong wrote:

*As to this coming of rain from the mountains, some hold that the clouds carry the rain with them, dispersing as it is precipitated (and they are right). Clouds and rain are really the same thing. Water evaporating upwards becomes clouds, which condense into rain, or still further into dew.*

**Middle Ages**

- **500 AD** – In around 500 AD, the Indian astronomer, mathematician, and astrologer: Varāhamihira published his work Brihat-Samhita's, which provides clear evidence that a deep knowledge of atmospheric processes existed in the Indian region.

- **7th century** – The poet Kalidasa in his epic Meghaduta, mentions the date of onset of the south-west Monsoon over central India and traces the path of the monsoon clouds.

- **7th century** – St. Isidore of Seville, in his work *De Rerum Natura*, writes about astronomy, cosmology and meteorology. In the chapter dedicated to Meteorology, he discusses the thunder, clouds, rainbows and wind.

- **9th century** – Al-Kindi (Alkindus), an Arab naturalist, writes a treatise on meteorology entitled *Risala fi l-Illa al-Failali l-Madd wa l-Fazr* (*Treatise on the Efficient Cause of the Flow and Ebb*), in which he presents an argument on tides which "depends on the changes which take place in bodies owing to the rise and fall of temperature."

- **9th century** – Al-Dinawari, a Kurdish naturalist, writes the *Kitab al-Nabat* (*Book of Plants*), in which he deals with the application of meteorology to agriculture during the Muslim Agricultural Revolution. He describes the meteorological character of the sky, the planets and constellations, the Sun and Moon, the lunar phases indicating seasons and rain, the *anwa* (heavenly bodies of rain), and atmospheric phenomena such as winds, thunder, lightning, snow, floods, valleys, rivers, lakes, wells and other sources of water.

- **10th century** – Ibn Wahshiyya's *Nabatean Agriculture* discusses the weather forecasting of atmospheric changes and signs from the planetary astral alterations; signs of rain based on observation of the lunar phases, nature of thunder and lightning, direction of sunrise, behaviour of certain plants and animals, and weather forecasts based on the movement of winds; pollenized air and winds; and formation of winds and vapours.

- **1021** – Ibn al-Haytham (Alhazen) writes on the atmospheric refraction of light, the cause of morning and evening twilight. He endeavored by use of hyperbola and geometric optics to chart and formulate basic laws on atmospheric refraction. He provides the first correct definition of the twilight, discusses atmospheric refraction, shows that the twilight is due to atmospheric refraction and only begins
when the Sun is 19 degrees below the horizon, and uses a complex geometric demonstration to measure the height of the Earth's atmosphere as 52,000 passuum (49 miles), which is very close to the modern measurement of 50 miles.

- 1020s – Ibn al-Haytham publishes his Risala fi l-Daw' (Treatise on Light) as a supplement to his Book of Optics. He discusses the meteorology of the rainbow, the density of the atmosphere, and various celestial phenomena, including the eclipse, twilight and moonlight.

- 1027 – Avicenna publishes The Book of Healing, in which Part 2, Section 5, contains his essay on mineralogy and meteorology in six chapters: formation of mountains; the advantages of mountains in the formation of clouds; sources of water; origin of earthquakes; formation of minerals; and the diversity of earth's terrain. He also describes the structure of a meteor, and his theory on the formation of metals combined Ja'far ibn Hayyān's sulfur–mercury theory from Islamic alchemy (although he was critical of alchemy) with the mineralogical theories of Aristotle and Theophrastus. His scientific methodology of field observation was also original in the Earth sciences.

- Late 11th century – Abu 'Abd Allah Muhammad ibn Ma'udh, who lived in Al-Andalus, wrote a work on optics later translated into Latin as Liber de crepisculis, which was mistakenly attributed to Alhazen. This was a short work containing an estimation of the angle of depression of the sun at the beginning of the morning twilight and at the end of the evening twilight, and an attempt to calculate on the basis of this and other data the height of the atmospheric moisture responsible for the refraction of the sun's rays. Through his experiments, he obtained the accurate value of 18°, which comes close to the modern value.

- 1088 – In his Dream Pool Essays, the Chinese scientist Shen Kuo wrote vivid descriptions of tornadoes, that rainbows were formed by the shadow of the sun in rain, occurring when the sun would shine upon it, and the curious common phenomena of the effect of lightning that, when striking a house, would merely scorch the walls a bit but completely melt to liquid all metal objects inside.

- 1121 – Al-Khazini, a Muslim scientist of Byzantine Greek descent, publishes The Book of the Balance of Wisdom, the first study on the hydrostatic balance.

- 13th century-St. Albert the Great is the first to propose that each drop of falling rain had the form of a small sphere, and that this form meant that the rainbow was produced by light interacting with each raindrop.

- 1267 – Roger Bacon was the first to calculate the angular size of the rainbow. He stated that the rainbow summit can not appear higher than 42 degrees above the horizon.

- 1337 – William Merle, rector of Driby, starts recording his weather diary, the oldest existing in print. The endeavour ended 1344.

- Late 13th century – Theoderic of Freiburg and Kamāl al-Dīn al-Fārisī give the first accurate explanations of the primary rainbow, simultaneously but independently. Theoderic also gives the explanation for the secondary rainbow.
King Sejong's son, Prince Munjong, invented the first standardized rain gauge. These were sent throughout the Joseon Dynasty of Korea as an official tool to assess land taxes based upon a farmer's potential harvest.

Leone Battista Alberti developed a swinging-plate anemometer, and is known as the first anemometer.

Nicolas Cryfts, (Nicolas of Cusa), described the first hair hygrometer to measure humidity. The design was drawn by Leonardo da Vinci, referencing Cryfts design in *da Vinci's Codex Atlanticus*.

Yuriy Drohobych publishes *Prognostic Estimation of the year 1483* in Rome, where he reflects upon weather forecasting and that climatic conditions depended on the latitude.

Johannes Lichtenberger publishes the first version of his *Prognosticatio* linking weather forecasting with astrology. The paradigm was only challenged centuries later.

During his second voyage Christopher Columbus experiences a tropical cyclone in the Atlantic Ocean, which leads to the first written European account of a hurricane.

Leonhard Reynmann, astronomer of Nuremberg, publishes "Wetterbüchlein Von warer erkanntnus des wetters", a collection of weather lore.

Antonio Mizauld publishes "Le miroueer du temps, autrement dit, éphémérides perpétuelles de l'air par lesquelles sont tous les jours donez vrais signes de touts changements de temps, seulement par choses qui à tous appairoissent au cien, en l'air, sur terre & en l'eau. Le tout par petits aphorismes, & breves sentences diligemment compris" in Paris, with detail on forecasting weather, comets and earthquakes.

**17th century**

Galileo Galilei constructs a thermoscope. Not only did this device measure temperature, but it represented a paradigm shift. Up to this point, heat and cold were believed to be qualities of Aristotle's elements (fire, water, air, and earth). *Note: There is some controversy about who actually built this first thermoscope. There is some evidence for this device being independently built at several different times.* This is the era of the first recorded meteorological observations. As there was no standard measurement, they were of little use until the work of Daniel Gabriel Fahrenheit and Anders Celsius in the 18th century.
• 1611 – Johannes Kepler writes the first scientific treatise on snow crystals: "Strena Seu de Nive Sexangula (A New Year's Gift of Hexagonal Snow)".

• 1620 – Francis Bacon (philosopher) analyzes the scientific method in his philosophical work; Novum Organum.

• 1643 – Evangelista Torricelli invents the **mercury barometer**.

• 1648 – Blaise Pascal rediscovers that atmospheric pressure decreases with height, and deduces that there is a vacuum above the atmosphere.

• 1654 – Ferdinando II de Medici sponsors the first *weather observing* network, that consisted of meteorological stations in Florence, Cutigliano, Vallombrosa, Bologna, Parma, Milan, Innsbruck, Osnabrück, Paris and Warsaw. Collected data was centrally sent to Accademia del Cimento in Florence at regular time intervals.

• 1662 – Sir Christopher Wren invented the mechanical, self-emptying, **tipping bucket rain gauge**.

• 1667 – Robert Hooke builds another type of anemometer, called a **pressure-plate anemometer**.

• 1686 – Edmund Halley presents a systematic study of the trade winds and monsoons and identifies solar heating as the cause of atmospheric motions.

  – Edmund Halley establishes the relationship between barometric pressure and height above sea level.

**18th century**

• 1716 – Edmund Halley suggests that aurorae are caused by "magnetic effluvia" moving along the Earth's magnetic field lines.

• 1724 – Gabriel Fahrenheit creates reliable scale for measuring temperature with a mercury-type thermometer.

• 1735 – The first *ideal* explanation of global circulation was the study of the Trade winds by George Hadley.

• 1738 – Daniel Bernoulli publishes *Hydrodynamics*, initiating the kinetic theory of gases. He gave a poorly detailed equation of state, but also the basic laws for the theory of gases.
• 1742 – Anders Celsius, a Swedish astronomer, proposed the Celsius temperature scale which led to the current Celsius scale.

• 1743 – Benjamin Franklin is prevented from seeing a lunar eclipse by a hurricane, he decides that cyclones move in a contrary manner to the winds at their periphery.

• 1761 – Joseph Black discovers that ice absorbs heat without changing its temperature when melting.

• 1772 – Black's student Daniel Rutherford discovers nitrogen, which he calls phlogisticated air, and together they explain the results in terms of the phlogiston theory.

• 1774 – Louis Cotte is put in charge of a "medico-meteorological" network of French veterinarians and country doctors to investigate the relationship between plague and weather. The project continued until 1794.

- Royal Society begins twice daily observations compiled by Samuel Horsley testing for the influence of winds and of the moon on the barometer readings.

• 1777 – Antoine Lavoisier discovers oxygen and develops an explanation for combustion.

• 1780 – Charles Theodor charters the first international network of meteorological observers known as "Societas Meteorologica Palatina". The project collapses in 1795.

• 1780 – James Six invents the Six's thermometer, a thermometer that records minimum and maximum temperatures.

• 1783 – In Lavoisier's article "Reflexions sur le phlogistique", he deprecates the phlogiston theory and proposes a caloric theory of heat.

  – First hair hygrometer demonstrated. The inventor was Horace-Bénédict de Saussure.

19th century

• 1800 – The Voltaic pile was the first modern electric battery, invented by Alessandro Volta, which led to later inventions like the telegraph.

• 1802–1803 – Luke Howard writes On the Modification of Clouds in which he assigns cloud types Latin names. Howard's system establishes three physical categories or forms based on appearance and process of formation: cirriform (mainly detached and wispy), cumuliform or convective (mostly detached and heaped, rolled, or rippled), and non-convective stratiform (mainly continuous layers in sheets). These are cross-classified into lower and upper levels or étages. Cumuliform clouds forming in the lower level are given the genus name cumulus from the Latin word for heap, while low stratiform clouds are given the
genus name stratus from the Latin word for a flattened or spread out sheet. Cirriform clouds are identified as always upper level and given the genus name cirrus from the Latin for hair. From this genus name, the prefix cirro- is derived and attached to the names of upper level cumulus and stratus, yielding the names cirrocumulus, and cirrostratus. In addition to these individual cloud types; Howard adds two names to designate cloud systems consisting of more than one form joined together or located in very close proximity. Cumulostratus describes large cumulus clouds blended with stratiform layers in the lower or upper levels. The term nimbus, taken from the Latin word for rain cloud, is given to complex systems of cirriform, cumuliform, and stratiform clouds with sufficient vertical development to produce significant precipitation, and it comes to be identified as a distinct nimiform physical category.

- 1804 – Sir John Leslie observes that a matte black surface radiates heat more effectively than a polished surface, suggesting the importance of black-body radiation.
- 1806 – Francis Beaufort introduces his system for classifying wind speeds.
- 1808 – John Dalton defends caloric theory in A New System of Chemistry and describes how it combines with matter, especially gases; he proposes that the heat capacity of gases varies inversely with atomic weight.
- 1810 – Sir John Leslie freezes water to ice artificially.
- 1817 – Alexander von Humboldt publishes a global map of average temperature, the first global climate analysis.
- 1819 – Pierre Louis Dulong and Alexis Thérèse Petit give the Dulong-Petit law for the specific heat capacity of a crystal.
- 1820 – Heinrich Wilhelm Brandes publishes the first synoptic weather maps.
  – John Herapath develops some ideas in the kinetic theory of gases but mistakenly associates temperature with molecular momentum rather than kinetic energy; his work receives little attention other than from Joule.
- 1822 – Joseph Fourier formally introduces the use of dimensions for physical quantities in his Théorie Analytique de la Chaleur.
- 1824 – Sadi Carnot analyzes the efficiency of steam engines using caloric theory; he develops the notion of a reversible process and, in postulating that no such thing exists in nature, lays the foundation for the second law of thermodynamics.
- 1832 – An electromagnetic telegraph was created by Baron Schilling.
- 1834 – Émile Clapeyron popularises Carnot's work through a graphical and analytic formulation.
1835 – Gaspard-Gustave Coriolis publishes theoretical discussions of machines with revolving parts and their efficiency, for example the efficiency of waterwheels. At the end of the 19th century, meteorologists recognized that the way the Earth's rotation is taken into account in meteorology is analogous to what Coriolis discussed: an example of Coriolis Effect.

1836 – An American scientist, Dr. David Alter, invented the first known American electric telegraph in Elderton, Pennsylvania, one year before the much more popular Morse telegraph was invented.

1837 – Samuel Morse independently developed an electrical telegraph, an alternative design that was capable of transmitting over long distances using poor quality wire. His assistant, Alfred Vail, developed the Morse code signaling alphabet with Morse. The first electric telegram using this device was sent by Morse on May 24, 1844 from the U.S. Capitol in Washington, D.C. to the B&O Railroad "outer depot" in Baltimore and sent the message:

*What hath God wrought*

1839 – The *first commercial* electrical telegraph was constructed by Sir William Fothergill Cooke and entered use on the Great Western Railway. Cooke and Wheatstone patented it in May 1837 as an alarm system.

1840 – Elias Loomis becomes the first person known to attempt to devise a theory on frontal zones. The idea of fronts do not catch on until expanded upon by the Norwegians in the years following World War I.

– German meteorologist Ludwig Kaemtz adds stratocumulus to Howard's canon as a mostly detached low-étage genus of *limited* convection. It is defined as having cumuliform and stratiform characteristics integrated into a single layer (in contrast to cumulostratus which is deemed to be composite in nature and can be structured into more than one layer). This eventually leads to the formal recognition of a *stratocumuliform* physical category that includes rolled and rippled clouds classified separately from the more freely convective heaped cumuliform clouds.

1843 – John James Waterston fully expounds the kinetic theory of gases, but is ridiculed and ignored.

– James Prescott Joule experimentally finds the mechanical equivalent of heat.

1844 – Lucien Vidi invented the aneroid, from Greek meaning *without liquid*, barometer.

1845 – Francis Ronalds invented the first successful camera for continuous recording of the variations in meteorological parameters over time

1845 – Francis Ronalds invented and named the storm clock, used to monitor rapid changes in meteorological parameters during extreme events

1846 – Cup anemometer invented by Dr. John Thomas Romney Robinson.
- 1847 – Francis Ronalds and William Radcliffe Birt described a stable kite to make observations at altitude using self-recording instruments.
- 1847 – Hermann von Helmholtz publishes a definitive statement of the conservation of energy, the first law of thermodynamics.
  - The Manchester Examiner newspaper organises the first weather reports collected by electrical means.
- 1848 – William Thomson extends the concept of absolute zero from gases to all substances.
- 1849 – Smithsonian Institution begins to establish an observation network across the United States, with 150 observers via telegraph, under the leadership of Joseph Henry.
  - William John Macquorn Rankine calculates the correct relationship between saturated vapour pressure and temperature using his hypothesis of molecular vortices.
- 1850 – Rankine uses his vortex theory to establish accurate relationships between the temperature, pressure, and density of gases, and expressions for the latent heat of evaporation of a liquid; he accurately predicts the surprising fact that the apparent specific heat of saturated steam will be negative.
  - Rudolf Clausius gives the first clear joint statement of the first and second law of thermodynamics, abandoning the caloric theory, but preserving Carnot's principle.
- 1852 – Joule and Thomson demonstrate that a rapidly expanding gas cools, later named the Joule-Thomson effect.
- 1853 – The first International Meteorological Conference was held in Brussels at the initiative of Matthew Fontaine Maury, U.S. Navy, recommending standard observing times, methods of observation and logging format for weather reports from ships at sea.
- 1854 – The French astronomer Leverrier showed that a storm in the Black Sea could be followed across Europe and would have been predictable if the telegraph had been used. A service of storm forecasts was established a year later by the Paris Observatory.
  - Rankine introduces his thermodynamic function, later identified as entropy.
- Mid 1850s – Emilien Renou, director of the Parc Saint-Maur and Montsouris observatories, begins work on an elaboration of Howard's classifications that would lead to the introduction during the 1870s of a newly defined middle étage. Clouds in this altitude range are given the prefix alto- derived from the Latin word altum pertaining to height above the low-level clouds. This results in the genus
name altocumulus for mid-level cumuliform and stratocumuliform types and altostratus for stratiform types in the same altitude range.

- 1856 – William Ferrel publishes his essay on the winds and the currents of the oceans.
- 1859 – James Clerk Maxwell discovers the distribution law of molecular velocities.
- 1860 – Robert FitzRoy uses the new telegraph system to gather daily observations from across England and produces the first synoptic charts. He also coined the term "weather forecast" and his were the first ever daily weather forecasts to be published in this year.

- After establishment in 1849, 500 U.S. telegraph stations are now making weather observations and submitting them back to the Smithsonian Institution. The observations are later interrupted by the American Civil War.

- 1865 – Josef Loschmidt applies Maxwell's theory to estimate the number-density of molecules in gases, given observed gas viscosities.

- Manila Observatory founded in the Philippines.

- 1869 – Joseph Lockyer starts the scientific journal *Nature*.
- 1869 – The New York Meteorological Observatory opens, and begins to record wind, precipitation and temperature data.
- 1870 – The US Weather Bureau is founded. Data recorded in several Midwestern cities such as Chicago begins.
- 1870 – Benito Viñes becomes the head of the Meteorological Observatory at Belen in Havana, Cuba. He develops the first observing network in Cuba and creates some of the first hurricane-related forecasts.
- 1872 – The "Oficina Meteorológica Argentina" (today "Argentinean National Weather Service") is founded.
- 1872 – Ludwig Boltzmann states the Boltzmann equation for the temporal development of distribution functions in phase space, and publishes his H-theorem.
- 1873 – International Meteorological Organization formed in Vienna.

- United States Army Signal Corp, forerunner of the National Weather Service, issues its first hurricane warning.
• 1875 – The India Meteorological Department is established, after a tropical cyclone struck Calcutta in 1864 and monsoon failures during 1866 and 1871.

• 1876 – Josiah Willard Gibbs publishes the first of two papers (the second appears in 1878) which discuss phase equilibria, statistical ensembles, the free energy as the driving force behind chemical reactions, and chemical thermodynamics in general.

• 1880 – Philip Weilbach, secretary and librarian at the Art Academy in Copenhagen proposes and has accepted by the permanent committee of the International Meteorological Organization (IMO), a forerunner of the present-day World Meteorological Organization (WMO), the designation of a new free-convective vertical or multi-étage genus type, cumulonimbus (heaped rain cloud). It would be distinct from cumulus and nimbus and identifiable by its often very complex structure (frequently including a cirriform top and what are now recognized as multiple accessory clouds), and its ability to produce thunder. With this addition, a canon of ten tropospheric cloud genera is established that comes to be officially and universally accepted. Howard's cumulostratus is not included as a distinct type, having effectively been reclassified into its component cumuliform and stratiform genus types already included in the new canon.

• 1881 – Finnish Meteorological Central Office was formed from part of Magnetic Observatory of Helsinki University.

• 1890 – US Weather Bureau is created as a civilian operation under the U.S. Department of Agriculture.

– Otto Jesse reveals the discovery and identification of the first clouds known to form above the troposphere. He proposes the name noctilucent which is Latin for night shining. Because of the extremely high altitudes of these clouds in what is now known to be the mesosphere, they can become illuminated by the sun's rays when the sky is nearly dark after sunset and before sunrise.

• 1892 – William Henry Dines invented another kind of anemometer, called the pressure-tube (Dines) anemometer. His device measured the difference in pressure arising from wind blowing in a tube versus that blowing across the tube.

– The first mention of the term "El Niño" to refer to climate occurs when Captain Camilo Carrilo told the Geographical society congress in Lima that Peruvian sailors named the warm northerly current "El Niño" because it was most noticeable around Christmas.

• 1893 – Henrik Mohn reveals a discovery of nacreous clouds in what is now considered the stratosphere.

• 1896 – IMO publishes the first International cloud atlas.

– Svante Arrhenius proposes carbon dioxide as a key factor to explain the ice ages.
H.H. Clayton proposes formalizing the division of clouds by their physical structures into cirriform, stratiform, "flocciform" (stratocumuliform) and cumuliform. With the later addition of cumulonimbiform, the idea eventually finds favor as an aid in the analysis of satellite cloud images.

- 1898 – US Weather Bureau established a hurricane warning network at Kingston, Jamaica.

20th century

- 1902 – Richard Assmann and Léon Teisserenc de Bort, two European scientists, independently discovered the stratosphere.

  - The Marconi Company issues the first routine weather forecast by means of radio to ships on sea. Weather reports from ships started 1905.

- 1903 – Max Margules publishes „Über die Energie der Stürme“, an essay on the atmosphere as a three-dimensional thermodynamical machine.

- 1904 – Vilhelm Bjerknes presents the vision that forecasting the weather is feasible based on mathematical methods.

- 1905 – Australian Bureau of Meteorology established by a Meteorology Act to unify existing state meteorological services.

- 1919 – Norwegian cyclone model introduced for the first time in meteorological literature. Marks a revolution in the way the atmosphere is conceived and immediately starts leading to improved forecasts.

  - Sakuhei Fujiwhara is the first to note that hurricanes move with the larger scale flow, and later publishes a paper on the Fujiwhara effect in 1921.

- 1920 – Milutin Milanković proposes that long term climatic cycles may be due to changes in the eccentricity of the Earth's orbit and changes in the Earth's obliquity.

- 1922 – Lewis Fry Richardson organises the first numerical weather prediction experiment.

- 1923 – The oscillation effects of ENSO were first erroneously described by Sir Gilbert Thomas Walker from whom the Walker circulation takes its name; now an important aspect of the Pacific ENSO phenomenon.

- 1924 – Gilbert Walker first coined the term "Southern Oscillation".

- 1930, January 30 – Pavel Molchanov invents and launches the first radiosonde. Named "271120", it was released 13:44 Moscow Time in Pavlovsk, USSR from the Main Geophysical Observatory, reached a
height of 7.8 kilometers measuring temperature there (~40.7 °C) and sent the first aerological message to the Leningrad Weather Bureau and Moscow Central Forecast Institute.

- 1932 – A further modification of Luke Howard's cloud classification system comes when an IMC commission for the study of clouds puts forward a refined and more restricted definition of the genus nimbus which is effectively reclassified as a stratiform cloud type. It is renamed nimbostratus (flattened or spread out rain cloud) and published with the new name in the 1932 edition of the *International Atlas of Clouds and of States of the Sky*. This leaves cumulonimbus as the only nimbiform type as indicated by its root-name.

- 1933 – Victor Schauberger publishes his theories on the carbon cycle and its relationship to the weather in *Our Senseless Toil*

- 1935 – IMO decides on the 30 years normal period (1900–1930) to describe the climate.

- 1937 – The U.S. Army Air Forces Weather Service was established (redesignated in 1946 as AWS-Air Weather Service).

- 1938 – Guy Stewart Callendar first to propose global warming from carbon dioxide emissions.

- 1939 – Rossby waves were first identified in the atmosphere by Carl-Gustaf Arvid Rossby who explained their motion. Rossby waves are a subset of inertial waves.

- 1941 – Pulsed radar network is implemented in England during World War II. Generally during the war, operators started noticing echoes from weather elements such as rain and snow.

- 1943 – 10 years after flying into the Washington Hoover Airport on mainly instruments during the August 1933 Chesapeake-Potomac hurricane, J. B. Duckworth flies his airplane into a Gulf hurricane off the coast of Texas, proving to the military and meteorological community the utility of weather reconnaissance.

- 1944 – The Great Atlantic Hurricane is caught on radar near the Mid-Atlantic coast, the first such picture noted from the United States.

- 1947 – The Soviet Union launched its first Long Range Ballistic Rocket October 18, based on the German rocket A4 (V-2). The photographs demonstrated the immense potential of observing weather from space.

- 1948 – First correct tornado prediction by Robert C. Miller and E. J. Fawbush for tornado in Oklahoma.

  - Erik Palmén publishes his findings that hurricanes require surface water temperatures of at least 26°C (80°F) in order to form.

- 1950 – First successful numerical weather prediction experiment. Princeton University, group of Jule Gregory Charney on ENIAC.

  - Hurricanes begin to be named alphabetically with the radio alphabet.
World Meteorological Organization replaces IMO under the auspice of the United Nations.

- **1953** – National Hurricane Center (NOAA) creates a system for naming hurricanes using alphabetical lists of women's names.


  – A United States Navy rocket captures a picture of an inland tropical depression near the Texas/Mexico border, which leads to a surprise flood event in New Mexico. This convinces the government to set up a weather satellite program.


  – **NSSP** National Severe Storms Project and **NHRP** National Hurricane Research Projects established. The Miami office of the United States Weather Bureau is designated the main hurricane warning center for the Atlantic Basin.

- **1957**–**1958** – International Geophysical Year coordinated research efforts in eleven sciences, focused on polar areas during the solar maximum.

- **1959** – The first weather satellite, Vanguard 2, was launched on February 17. It was designed to measure cloud cover, but a poor axis of rotation kept it from collecting a notable amount of useful data.

- **1960** – The first successful weather satellite, TIROS-1 (Television Infrared Observation Satellite), is launched on April 1 from Cape Canaveral, Florida by the National Aeronautics and Space Administration (NASA) with the participation of The US Army Signal Research and Development Lab, RCA, the US Weather Bureau, and the US Naval Photographic Center. During its 78-day mission, it relays thousands of pictures showing the structure of large-scale cloud regimes, and proves that satellites can provide useful surveillance of global weather conditions from space. TIROS paves the way for the Nimbus program, whose technology and findings are the heritage of most of the Earth-observing satellites NASA and NOAA have launched since then.

- **1961** – Edward Lorenz accidentally discovers Chaos theory when working on numerical weather prediction.
• 1962 – Keith Browning and Frank Ludlam publish first detailed study of a *supercell* storm (over Wokingham, UK). Project STORMFURY begins its 10-year project of seeding hurricanes with silver iodide, attempting to weaken the cyclones.

• 1968 – A hurricane database for Atlantic hurricanes is created for NASA by Charlie Newmann and John Hope, named HURDAT.

• 1969 – Saffir–Simpson Hurricane Scale created, used to describe hurricane strength on a category range of 1 to 5. Popularized during Hurricane Gloria of 1985 by media.

  – Jacob Bjerknes described ENSO by suggesting that an anomalously warm spot in the eastern Pacific can weaken the east-west temperature difference, causing weakening in the Walker circulation and trade wind flows, which push warm water to the west.

• 1970s Weather radars are becoming more standardized and organized into networks. The number of scanned angles was increased to get a three-dimensional view of the precipitation, which allowed studies of thunderstorms. Experiments with the Doppler effect begin.

• 1970 – **NOAA** National Oceanic and Atmospheric Administration established. Weather Bureau is renamed the National Weather Service.

• 1971 – Ted Fujita introduces the Fujita scale for rating tornadoes.

• 1974 – **AMeDAS** network, developed by Japan Meteorological Agency used for gathering regional weather data and verifying forecast performance, begun operation on November 1, the system consists of about 1,300 stations with automatic observation equipment. These stations, of which more than 1,100 are unmanned, are located at an average interval of 17 km throughout Japan.

• 1975 – The first Geostationary Operational Environmental Satellite, **GOES**, was launched into orbit. Their role and design is to aid in hurricane tracking. Also this year, Vern Dvorak develops a scheme to estimate tropical cyclone intensity from satellite imagery.


• 1976 – The United Kingdom Department of Industry publishes a modification of the international cloud classification system adapted for satellite cloud observations. It is co-sponsored by NASA and shows a division of clouds into stratiform, cirriform, stratocumuliform, cumuliform, and cumulonimbiform. The last of these constitutes a change in name of the earlier nimboform type, although this earlier name and original meaning pertaining to all rain clouds can still be found in some classifications.
• 1980s onwards, networks of weather radars are further expanded in the developed world. Doppler weather radar is becoming gradually more common, adds velocity information.

• 1982 – The first Synoptic Flow experiment is flown around Hurricane Debby to help define the large scale atmospheric winds that steer the storm.

• 1988 – WSR-88D type weather radar implemented in the United States. Weather surveillance radar that uses several modes to detect severe weather conditions.

• 1992 – Computers first used in the United States to draw surface analyses.

• 1997 – The Pacific Decadal Oscillation was discovered by a team studying salmon production patterns at the University of Washington.

• 1998 – Improving technology and software finally allows for the digital underlying of satellite imagery, radar imagery, model data, and surface observations improving the quality of United States Surface Analyses.

– CAMEX3, a NASA experiment run in conjunction with NOAA’s Hurricane Field Program collects detailed data sets on Hurricanes Bonnie, Danielle, and Georges.

• 1999 – Hurricane Floyd induces *fright factor* in some coastal States and causes a massive evacuation from coastal zones from northern Florida to the Carolinas. It comes ashore in North Carolina and results in nearly 80 dead and $4.5 billion in damages mostly due to extensive flooding.

**21st century**

• 2001 – National Weather Service begins to produce a Unified Surface Analysis, ending duplication of effort at the Tropical Prediction Center, Ocean Prediction Center, Hydrometeorological Prediction Center, as well as the National Weather Service offices in Anchorage, AK and Honolulu, HI.


• 2004 – A record number of hurricanes strike Florida in one year, Charley, Frances, Ivan, and Jeanne.

• 2005 – A record 27 named storms occur in the Atlantic. National Hurricane Center runs out of names from its standard list and uses Greek alphabet for the first time.

• 2006 – Weather radar improved by adding common precipitation to it such as freezing rain, rain and snow mixed, and snow for the first time.

• 2007 – The Fujita scale is replaced with the Enhanced Fujita Scale for National Weather Service tornado assessments.

• 2010s – Weather radar dramatically advances with more detailed options.
Timeline of the English Civil War

Events prior to the English Civil War

- 1625 - Charles I of England accedes to the English throne, and shortly after marries a French Roman Catholic princess, Henrietta Maria
- 1625 - Act of Revocation (Scotland) to reallocate all Church/Crown lands acquired since the Reformation (1540) 2/3 of which are in the hands of Scottish nobles.
- 1626 - Parliament dismisses George Villiers, 1st Duke of Buckingham from command of English forces in Europe; Charles I, furious, dismisses Parliament.
- 1629 - Charles dismisses Parliament and does not call it again until 1640, thus commencing the Personal Rule
- 1637 - Charles attempts to impose Anglican services on the Presbyterian Church of Scotland, Jenny Geddes reacts starting a tumult which leads to the National Covenant.
- 1639–1640 - Bishops' Wars start in Scotland.

1640

- 13 April, first meeting of the Short Parliament
- 5 May, Charles dissolves the Short Parliament
- 26 October, Charles forced to sign the Treaty of Ripon.
- 3 November, first meeting of the Long Parliament.
- 11 December, the Root and Branch Petition submitted to the Long Parliament

1641

- July, the Long Parliament passes "An Act for the Regulating the Privie Councell and for taking away the Court commonly called the Star Chamber"
- July, Charles returns to Scotland and accedes to all Covenanter demands
- August, the Root and Branch Bill rejected by the Long Parliament
- October, outbreak of the Irish Rebellion of 1641
• 1 December - The Grand Remonstrance is presented to the King
• December - The Long Parliament passes the Bishops Exclusion Act

1642 until the outbreak of the war

• 4 January, Charles unsuccessfully attempts to personally arrest the Five Members (John Pym, John Hampden, Denzil Holles, Sir Arthur Haselrig, and William Strode) on the floor of the House of Commons
• January, on the orders of the Long Parliament, Sir John Hotham, 1st Baronet seizes the arsenal at Kingston upon Hull
• 5 February, the bishops of the Church of England are excluded from the House of Lords by the Bishops Exclusion Act
• 23 February - Henrietta Maria goes to the Netherlands with Princess Mary and the crown jewels
• 5 March, the Long Parliament passes the Militia Ordinance
• 15 March, the Long Parliament proclaims that "the People are bound by the Ordinance for the Militia, though it has not received the Royal Assent"
• April, Sir John Hotham, 1st Baronet refuses the king entrance to Kingston upon Hull
• 2 June - The Nineteen Propositions rejected
• May - The Irish rebellion ends
• 3 June, The great meeting on Heworth Moor outside York, summoned by Charles to garner support for his cause.
• July, Charles I of England unsuccessfully besieged Hull
• July, Parliament appoints the Committee of Safety

The First English Civil War

Events of 1642

• 22 August, King Charles I raises his standard at Nottingham and the war commences
• 23 August, Battle of Southam, first sizeable encounter between Royalist & Parliamentarian forces.
• 19 September Charles's Wellington Declaration
• 23 September, Battle of Powick Bridge
• 29 September, The Yorkshire Treaty of Neutrality was signed, but was repudiated by Parliament 4 October.
• 17 October, King Charles I passed through Birmingham, the towns folk seized the Kings carriages, containing the royal plate and furniture, which they conveyed for security to Warwick Castle, a parliamentary stronghold. The same day there was a skirmish at Kings Norton

• 23 October, Battle of Edgehill

• 1 November, Battle of Aylesbury

• 12 November, Battle of Brentford.

• 13 November, Battle of Turnham Green

• 17 December, Declaration of Lex Talionis

• 1 December, Storming of Farnham Castle

• Early December, Battle of Muster Green

• 22 December, Siege of Chichester begins

• 23 December, Bunbury Agreement designed to keep Cheshire neutral during the Civil War (failed)

• 27 December, Siege of Chichester ends

**Events of 1643**

• 19 January, Battle of Braddock Down

• 28 January, the Long Parliament sends commissioners to negotiate the Treaty of Oxford (unsuccessful)

• 19 March, Battle of Hopton Heath

• 30 March, Battle of Seacroft Moor

• 3 April, Battle of Camp Hill — a Royalist victory

• 8-21 April, Siege of Lichfield — a Royalist capture

• 25 April, Battle of Sourton Down — Parliamentarian victory

• 16 May, Battle of Stratton — Royalist victory

• 29–31 May, Siege of Worcester — Parliamentarians failed to capture

• 16 June, the Long Parliament passes the Licensing Order

• 18 June, Battle of Chalgrove Field — John Hampden was mortally wounded during the Battle and died on Saturday evening of 24 June 1643.

• 30 June, Battle of Adwalton Moor

• 1 July, first meeting of the Westminster Assembly

• 4 July, Battle of Burton Bridge

• 5 July, Battle of Lansdowne (or Lansdown) fought near Bath.
• 13 July, Battle of Roundway Down fought near Devizes
• 20 July, Battle of Gainsborough
• 26 July, Storming of Bristol
• 17 August, the Church of Scotland ratifies the Solemn League and Covenant
• 2 September, Beginning of Siege of Hull (1643)
• 18 September, Battle of Aldbourne Chase
• 20 September, First Battle of Newbury
• 25 September, the Long Parliament and the Westminster Assembly ratify the Solemn League and Covenant. Under the terms of the deal with Scotland, the Committee of Safety is superseded by the Committee of Both Kingdoms
• 11 October, Battle of Winceby

Events of 1644

The Scots marched South and joined Parliament's army threatening York.

• 26 January, Battle of Nantwich
• 3 February, Siege of Newcastle, formal request to surrender to the Scots.
• 29 March, Battle of Cheriton
• 28 May, Storming of Bolton and the Bolton Massacre
• 29 June, Battle of Cropredy Bridge
• 2 July, Battle of Marston Moor
• 13 September, Second Battle of Aberdeen
• 19 October, Siege of Newcastle ends with the storming of the city by Scottish soldiers
• 24 October, the Long Parliament passes the Ordinance of no quarter to the Irish
• 27 October, Second Battle of Newcastle
• 23 November, first publication of Areopagitica by John Milton
• 4 November, the Long Parliament sends the Propositions of Uxbridge to the king at Oxford

Events of 1645

• 6 January, the Committee of Both Kingdoms orders the creation of the New Model Army
• 28 January, the Long Parliament appoints commissioners to meet with the king's commissioners at Uxbridge
• 22 February, negotiations over the Treaty of Uxbridge end unsuccessfully
• 23 April, the Long Parliament passes the Self-denying Ordinance
• 9 May, Battle of Auldearn
• 30 May, Siege & sacking of Leicester
• 14 June, Battle of Naseby
• 2 July, Battle of Alford
• 10 July, Battle of Langport
• 15 August, Battle of Killiecrankie
• 13 September, Battle of Philiphaugh
• 24 September, Battle of Rowton Heath
• Surrender of Leicester
• October fear of Royalist attack in south Lincolnshire
• Charles went to Welbeck, Nottinghamshire
• 17 December Siege of Hereford ended with the surrender of Royalist garrison.

Events of 1646

• 18 January, Siege of Dartmouth ended with the surrender of Royalist garrison.
• 3 February, Siege of Chester ended with the surrender of Royalist garrison after a 136-day siege.
• 16 February, Battle of Torrington victory for the New Model Army
• 10 March, Ralph Hopton surrenders the Royalist army at Tresillian bridge in Cornwall.
• 21 March, Battle of Stow-on-the-Wold the last pitched battle of the First Civil War is a victory for the New Model Army
• 13 April, Siege of Exeter ended with the surrender of Royalist garrison.
• 5 May, Charles surrendered to a Scottish army at Southwell, Nottinghamshire
• 6 May, Newark fell to the Parliamentarians
• 24 June, Siege of Oxford ended with the surrender of Royalist garrison.
• 22 July, Siege of Worcester ended with the surrender of Royalist garrison.
• 27 July, after a 65-day siege, Wallingford Castle, the last English royalist stronghold, surrenders to Sir Thomas Fairfax.
19 August, Royalist garrison of Raglan Castle surrendered (Wales)

9 October, the Long Parliament passes the *Ordinance for the abolishing of Archbishops and Bishops in England and Wales and for settling their lands and possessions upon Trustees for the use of the Commonwealth*

**Events of 1647**

- 13 March, Harlech Castle the last Royalist stronghold in Wales surrendered to the Parliamentary forces.
- 29 May, General Council of the Army drew-up the *Solemn Engagement*
- 3 June, Cornet George Joyce (a junior officer in Fairfax's horse) with a troop of New Model Army cavalry seizes the King from his Parliamentary guards at Holdenby House and place him in protective custody of the New Model Army
- 4–5 June, at a rendezvoused on Kentford Heath near Newmarket the officers and men of the New Model Army gave their assent to the *Solemn Engagement*
- 8 June, General Fairfax sent the *Solemn Engagement* to Parliament along with a letter explaining that the King was now in the custody of the Army negotiations would be conducted through New Model Army representatives
- 1 August, General Council of the Army offers the Heads of Proposals
- 31 August, Montrose escaped from the Highlands
- October, "An Agreement of the People for a firm and present peace upon grounds of common right", presented to the Army Council
- 28 October, Beginning of the Putney Debates. Ended 11 November.
- 26 December, a faction of Scottish Covenanters sign The Engagement with Charles I

**The Second English Civil War**

**Events of 1648**

- 8 May, Battle of St. Fagans
- 16 May (?) – 11 July Siege of Pembroke
- 1 June, Battle of Maidstone
- 13 June – 28 August, Siege of Colchester
- 17 August – 19 August, Battle of Preston
19 August, Battle of Winwick Pass.
28 August, On the evening of the surrender of Colchester, Royalists Sir Charles Lucas and Sir George Lisle were shot
15 September, Treaty of Newport
November, leaders in the army draft the Remonstrance of the Army
6 December, Pride's Purge, when troops under Colonel Thomas Pride removed opponents of Oliver Cromwell from Parliament by force of arms resulting in Rump Parliament

Events of 1649

15 January, "An Agreement of the People of England, and the places therewith incorporated, for a secure and present peace, upon grounds of common right, freedom and safety" presented to the Rump Parliament
20 January, The trial of Charles I of England by the High Court of Justice begins
27 January, The death warrant of Charles I of England is signed
30 January, Charles I of England executed by beheading - the Rump Parliament passes Act prohibiting the proclaiming any person to be King of England or Ireland, or the Dominions thereof
5 February, The eldest son of Charles I, Charles, Prince of Wales, was proclaimed "king of Great Britain, France and Ireland" by the Scottish Parliament at the Mercat Cross, Edinburgh.
7 February, The Rump Parliament votes to abolish the English monarchy
9 February, publication of Eikon Basilike, allegedly by Charles I of England
14 February, the Rump Parliament creates the English Council of State
February, Charles II proclaimed king of Great Britain, France and Ireland by Hugh, Viscount Montgomery and other Irish Royalists at Newtownards in Ulster.
9 March, Engager Duke of Hamilton, Royalist Earl of Holland, and Royalist Lord Capel were beheaded at Westminster
17 March, an Act abolishing the kingship is formally passed by the Rump Parliament.
24 March, The capitulation of Pontefract Castle which, even after the death of Charles I, remained loyal to Charles II
October, first publication of Eikonoklastes by John Milton, a rebuttal of Eikon Basilike
Third English Civil War

Events of 1650

- 1 May, Treaty of Breda signed between Charles II and the Scottish Covenanters
- 23 June, Charles II signs the Solemn League and Covenant
- 3 September, Battle of Dunbar, Scotland
- 1 December, Battle of Hieton, Scotland (skirmish)

Events of 1651

- 1 January, Charles II crowned King of Scots at Scone
- 20 July, Battle of Inverkeithing
- 25 August, Battle of Wigan Lane (skirmish)
- 28 August, Battle of Upton (the start of the western encirclement of Worcester)
- 3 September, Battle of Worcester
- 3 September, the start of the escape of Charles II
- 6 September, Charles II spends the day hiding in the Royal Oak in the woodlands surrounding Boscobel House
- 16 October, Charles II landed in Normandy, France, after successfully fleeing England

Events after the English Civil War

depthcount: royalists: 50,000, parliamentarians: 34,000

- 1650-1660, English Interregnum
  - 1649-1653, The first period of the Commonwealth of England
  - 20 April 1653, The Rump Parliament disbanded by Oliver Cromwell
  - 1653-1658, The Protectorate under Oliver Cromwell
  - 25 March 1655, Battle of the Severn was fought in the Province of Maryland and was won by a Puritan force fighting under a Commonwealth flag who defeated a Royalist force fighting for Lord Baltimore
  - 13 April 1657, Oliver Cromwell declines the crown of England
  - 3 September 1658, Death of Oliver Cromwell
1658-1659, The Protectorate under Richard Cromwell
7 May 1659, Rump Parliament restored by Richard Cromwell
25 May 1659, Richard Cromwell delivered a formal letter resigning the position of Lord Protector
13 October 1659, Rump Parliament disbanded again
1659-1660, The second period of the Commonwealth of England

1660, English Restoration and the return of King Charles II of England
30 January 1660, Charles II proclaimed King of England
March 1660, Convention Parliament elected
4 April 1660, Charles II issued the Declaration of Breda, which made known the conditions of his acceptance of the crown of England
25 April 1660, Convention Parliament assembled for the first time
29 May 1660, Charles II arrives in London and the English monarchy is restored
July 1660, Richard Cromwell left England for the Kingdom of France where he went by a variety of pseudonyms, including "John Clarke"
29 December 1660, Convention Parliament disbanded by Charles II
23 April 1661, coronation of Charles II at Westminster Abbey
1660-1662, The trials and executions of the regicides of Charles I
30 January 1661, On the 12th anniversary of the beheading of Charles I, the exhumed remains of Oliver Cromwell were posthumously executed (Cromwell's severed head was displayed on a pole outside Westminster Hall until 1685)

Timeline of quantum mechanics

19th century

- 1801 – Thomas Young establishes that light made up of waves with his Double-slit experiment.
- 1859 – Gustav Kirchhoff introduces the concept of a blackbody and proves that its emission spectrum depends only on its temperature.
- 1860-1900 – Ludwig Eduard Boltzmann, James Clerk Maxwell and others develop the theory of statistical mechanics. Boltzmann argues that entropy is a measure of disorder.
- 1877 – Boltzmann suggests that the energy levels of a physical system could be discrete based on statistical mechanics and mathematical arguments; also produces the first circle diagram representation, or atomic
model of a molecule (such as an iodine gas molecule) in terms of the overlapping terms $\alpha$ and $\beta$, later (in 1928) called molecular orbitals, of the constituting atoms.

- 1885 – Johann Jakob Balmer discovers a numerical relationship between visible spectral lines of hydrogen, the Balmer series.
- 1887 – Heinrich Hertz discovers the photoelectric effect, shown by Einstein in 1905 to involve *quanta* of light.
- 1888 – Hertz demonstrates experimentally that electromagnetic waves exist, as predicted by Maxwell.
- 1888 – Johannes Rydberg modifies the Balmer formula to include all spectral series of lines for the hydrogen atom, producing the Rydberg formula which is employed later by Niels Bohr and others to verify Bohr's first quantum model of the atom.
- 1895 – Wilhelm Conrad Röntgen discovers X-rays in experiments with electron beams in plasma.
- 1896 – Antoine Henri Becquerel accidentally discovers radioactivity while investigating the work of Wilhelm Conrad Röntgen; he finds that uranium salts emit radiation that resembled Röntgen's X-rays in their penetrating power. In one experiment, Becquerel wraps a sample of a phosphorescent substance, potassium uranyl sulfate, in photographic plates surrounded by very thick black paper in preparation for an experiment with bright sunlight; then, to his surprise, the photographic plates are already exposed before the experiment starts, showing a projected image of his sample.
- 1896-1897 – Pieter Zeeman first observes the Zeeman splitting effect by applying a magnetic field to light sources.
- 1896-1897 Marie Curie (née Skłodowska, Becquerel's doctoral student) investigates uranium salt samples using a very sensitive electrometer device that was invented 15 years before by her husband and his brother Jacques Curie to measure electrical charge. She discovers that rays emitted by the uranium salt samples make the surrounding air electrically conductive, and measures the emitted rays' intensity. In April 1898, through a systematic search of substances, she finds that thorium compounds, like those of uranium, emitted "Becquerel rays", thus preceding the work of Frederick Soddy and Ernest Rutherford on the nuclear decay of thorium to radium by three years.
- 1897 – Ivan Borgman demonstrates that X-rays and radioactive materials induce thermoluminescence.
- 1897 – J. J. Thomson's experimentation with cathode rays led him to suggest a fundamental unit more than a 1,000 times smaller than an atom, based on the high charge-to-mass ratio. He called the particle a "corpuscle", but later scientists preferred the term electron.
- 1899 to 1903 – Ernest Rutherford investigates radioactivity. He coins the terms alpha and beta rays in 1899 to describe the two distinct types of radiation emitted by thorium and uranium salts. Rutherford is joined at McGill University in 1900 by Frederick Soddy and together they discover nuclear transmutation when they find in 1902 that radioactive thorium is converting itself into radium through a process of nuclear decay and
a gas (later found to be \(^4\text{He}\)); they report their interpretation of radioactivity in 1903. Rutherford becomes known as the "father of nuclear physics" with his nuclear atom model of 1911.

20th century

1900–1909

* 1900 – To explain black-body radiation (1862), Max Planck suggests that electromagnetic energy could only be emitted in quantized form, i.e. the energy could only be a multiple of an elementary unit \( E = h\nu \), where \( h \) is Planck's constant and \( \nu \) is the frequency of the radiation.
* 1902 – To explain the octet rule (1893), Gilbert N. Lewis develops the "cubical atom" theory in which electrons in the form of dots are positioned at the corner of a cube. Predicts that single, double, or triple "bonds" result when two atoms are held together by multiple pairs of electrons (one pair for each bond) located between the two atoms.
* 1903 – Antoine Becquerel, Pierre Curie and Marie Curie share the 1903 Nobel Prize in Physics for their work on spontaneous radioactivity.
* 1904 – Richard Abegg notes the pattern that the numerical difference between the maximum positive valence, such as +6 for \( \text{H}_2\text{SO}_4 \), and the maximum negative valence, such as −2 for \( \text{H}_2\text{S} \), of an element tends to be eight (Abegg's rule).
* 1905 – Albert Einstein explains the photoelectric effect (reported in 1887 by Heinrich Hertz), i.e. that shining light on certain materials can function to eject electrons from the material. He postulates, as based on Planck's quantum hypothesis (1900), that light itself consists of individual quantum particles (photons).
* 1905 – Einstein explains the effects of Brownian motion as caused by the kinetic energy (i.e., movement) of atoms, which was subsequently, experimentally verified by Jean Baptiste Perrin, thereby settling the century-long dispute about the validity of John Dalton's atomic theory.
* 1905 – Einstein publishes his Special Theory of Relativity.
* 1905 – Einstein theoretically derives the equivalence of matter and energy.
* 1907 to 1917 – Ernest Rutherford: To test his planetary model of 1904, later known as the Rutherford model, he sent a beam of positively charged alpha particles onto a gold foil and noticed that some bounced back, thus showing that an atom has a small-sized positively charged atomic nucleus at its center. However, he received in 1908 the Nobel Prize in Chemistry "for his investigations into the disintegration of the elements, and the chemistry of radioactive substances", which followed on the work of Marie Curie, not for his planetary model of the atom; he is also widely credited with first "splitting the atom" in 1917. In 1911 Ernest Rutherford explained the Geiger–Marsden experiment by invoking a nuclear atom model and derived the Rutherford cross section.
• 1909 – Geoffrey Ingram Taylor demonstrates that interference patterns of light were generated even when the light energy introduced consisted of only one photon. This discovery of the wave–particle duality of matter and energy is fundamental to the later development of quantum field theory.

• 1909 and 1916 – Einstein shows that, if Planck's law of black-body radiation is accepted, the energy quanta must also carry momentum \( p = h / \lambda \), making them full-fledged particles.

1910–1919

• 1911 – Lise Meitner and Otto Hahn perform an experiment that shows that the energies of electrons emitted by beta decay had a continuous rather than discrete spectrum. This is in apparent contradiction to the law of conservation of energy, as it appeared that energy was lost in the beta decay process. A second problem is that the spin of the Nitrogen-14 atom was 1, in contradiction to the Rutherford prediction of \( \frac{1}{2} \). These anomalies are later explained by the discoveries of the neutrino and the neutron.

• 1911 – Ştefan Procopiu performs experiments in which he determines the correct value of electron's magnetic dipole moment, \( \mu_b = 9.27 \times 10^{-21} \text{ erg Oe}^{-1} \) (in 1913 he is also able to calculate a theoretical value of the Bohr magneton based on Planck's quantum theory).

• 1912 – Victor Hess discovers the existence of cosmic radiation.

• 1912 – Henri Poincaré publishes an influential mathematical argument in support of the essential nature of energy quanta.

• 1913 – Robert Andrews Millikan publishes the results of his "oil drop" experiment, in which he precisely determines the electric charge of the electron. Determination of the fundamental unit of electric charge makes it possible to calculate the Avogadro constant (which is the number of atoms or molecules in one mole of any substance) and thereby to determine the atomic weight of the atoms of each element.

• 1913 – Ştefan Procopiu publishes a theoretical paper with the correct value of the electron's magnetic dipole moment \( \mu_b \).

• 1913 – Niels Bohr obtains theoretically the value of the electron's magnetic dipole moment \( \mu_b \) as a consequence of his atom model

• 1913 – Johannes Stark and Antonino Lo Surdo independently discover the shifting and splitting of the spectral lines of atoms and molecules due to the presence of the light source in an external static electric field.

• 1913 – To explain the Rydberg formula (1888), which correctly modeled the light emission spectra of atomic hydrogen, Bohr hypothesizes that negatively charged electrons revolve around a positively charged nucleus at certain fixed "quantum" distances and that each of these "spherical orbits" has a specific energy associated with it such that electron movements between orbits requires "quantum" emissions or absorptions of energy.
• 1914 – James Franck and Gustav Hertz report their experiment on electron collisions with mercury atoms, which provides a new test of Bohr's quantized model of atomic energy levels.

• 1915 – Einstein first presents to the Prussian Academy of Science what are now known as the Einstein field equations. These equations specify how the geometry of space and time is influenced by whatever matter is present, and form the core of Einstein's General Theory of Relativity. Although this theory is not directly applicable to quantum mechanics, theorists of quantum gravity seek to reconcile them.

• 1916 – Paul Epstein and Karl Schwarzschild, working independently, derive equations for the linear and quadratic Stark effect in hydrogen.

• 1916 – Gilbert N. Lewis conceives the theoretical basis of Lewis dot formulas, diagrams that show the bonding between atoms of a molecule and the lone pairs of electrons that may exist in the molecule.

• 1916 – To account for the Zeeman effect (1896), i.e. that atomic absorption or emission spectral lines change when the light source is subjected to a magnetic field, Arnold Sommerfeld suggests there might be "elliptical orbits" in atoms in addition to spherical orbits.

• 1918 – Sir Ernest Rutherford notices that, when alpha particles are shot into nitrogen gas, his scintillation detectors shows the signatures of hydrogen nuclei. Rutherford determines that the only place this hydrogen could have come from was the nitrogen, and therefore nitrogen must contain hydrogen nuclei. He thus suggests that the hydrogen nucleus, which is known to have an atomic number of \( 1 \), is an elementary particle, which he decides must be the protons hypothesized by Eugen Goldstein.

• 1919 – Building on the work of Lewis (1916), Irving Langmuir coins the term "covalence" and postulates that coordinate covalent bonds occur when two electrons of a pair of atoms come from both atoms and are equally shared by them, thus explaining the fundamental nature of chemical bonding and molecular chemistry.

1920–1929

• 1920 - Hendrik Kramers uses Bohr–Sommerfeld quantization to derive formulas for intensities of spectral transitions of the Stark effect. Kramers also includes the effect of fine structure, including corrections for relativistic kinetic energy and coupling between electron spin and orbit.

• 1921–1922 – Frederick Soddy receives the Nobel Prize for 1921 in Chemistry one year later, in 1922, "for his contributions to our knowledge of the chemistry of radioactive substances, and his investigations into the origin and nature of isotopes"; he writes in his Nobel Lecture of 1922: "The interpretation of radioactivity which was published in 1903 by Sir Ernest Rutherford and myself ascribed the phenomena to the spontaneous disintegration of the atoms of the radio-element, whereby a part of the original atom was violently ejected as a radiant particle, and the remainder formed a totally new kind of atom with a distinct chemical and physical character."
- 1922 – Arthur Compton finds that X-ray wavelengths increase due to scattering of the radiant energy by free electrons. The scattered quanta have less energy than the quanta of the original ray. This discovery, known as the Compton effect or Compton scattering, demonstrates the particle concept of electromagnetic radiation.

- 1922 – Otto Stern and Walther Gerlach perform the Stern–Gerlach experiment, which detects discrete values of angular momentum for atoms in the ground state passing through an inhomogeneous magnetic field leading to the discovery of the spin of the electron.

- 1922 – Bohr updates his model of the atom to better explain the properties of the periodic table by assuming that certain numbers of electrons (for example 2, 8 and 18) corresponded to stable "closed shells", presaging orbital theory.

- 1923 – Pierre Auger discovers the Auger effect, where filling the inner-shell vacancy of an atom is accompanied by the emission of an electron from the same atom.

- 1923 – Louis de Broglie extends wave–particle duality to particles, postulating that electrons in motion are associated with waves. He predicts that the wavelengths are given by Planck's constant $h$ divided by the momentum of the electron: $\lambda = h / mv = h / p$.

- 1923 – Gilbert N. Lewis creates the theory of Lewis acids and bases based on the properties of electrons in molecules, defining an acid as accepting an electron lone pair from a base.


- 1924 – Wolfgang Pauli outlines the "Pauli exclusion principle" which states that no two identical fermions may occupy the same quantum state simultaneously, a fact that explains many features of the periodic table.

- 1925 – George Uhlenbeck and Samuel Goudsmit postulate the existence of electron spin.

- 1925 – Friedrich Hund outlines Hund's rule of Maximum Multiplicity which states that when electrons are added successively to an atom as many levels or orbits are singly occupied as possible before any pairing of electrons with opposite spin occurs and made the distinction that the inner electrons in molecules remained in atomic orbitals and only the valence electrons needed to be in molecular orbitals involving both nuclei.

- 1925 – Werner Heisenberg, Max Born, and Pascual Jordan develop the matrix mechanics formulation of Quantum Mechanics.

- 1926 – Lewis coins the term photon in a letter to the scientific journal Nature, which he derives from the Greek word for light, φως (transliterated phōs).

- 1926 – Oskar Klein and Walter Gordon state their relativistic quantum wave equation, later called the Klein–Gordon equation.
• 1926 – Enrico Fermi discovers the spin-statistics theorem connection.
• 1926 – Paul Dirac introduces Fermi–Dirac statistics.
• 1926 – Erwin Schrödinger uses De Broglie's electron wave postulate (1924) to develop a "wave equation" that represents mathematically the distribution of a charge of an electron distributed through space, being spherically symmetric or prominent in certain directions, i.e. directed valence bonds, which gives the correct values for spectral lines of the hydrogen atom; also introduces the Hamiltonian operator in quantum mechanics.
• 1926 – Paul Epstein reconsiders the linear and quadratic Stark effect from the point of view of the new quantum theory, using the equations of Schrödinger and others. The derived equations for the line intensities are a decided improvement over previous results obtained by Hans Kramers.
• 1926 to 1932 – John von Neumann lays the mathematical foundations of Quantum Mechanics in terms of Hermitian operators on Hilbert spaces, subsequently published in 1932 as a basic textbook of quantum mechanics.
• 1927 – Werner Heisenberg formulates the quantum uncertainty principle.
• 1927 – Niels Bohr and Werner Heisenberg develops the Copenhagen interpretation of the probabilistic nature of wavefunctions.
• 1927 – Born and J. Robert Oppenheimer introduce the Born–Oppenheimer approximation, which allows the quick approximation of the energy and wavefunctions of smaller molecules.
• 1927 – Walter Heitler and Fritz London introduce the concepts of valence bond theory and apply it to the hydrogen molecule.
• 1927 – Thomas and Fermi develop the Thomas–Fermi model for a Gas in a box.
• 1927 – Chandrasekhar Venkata Raman studies optical photon scattering by electrons.
• 1927 – Dirac states his relativistic electron quantum wave equation, the Dirac equation.
• 1927 – Charles Galton Darwin and Walter Gordon solve the Dirac equation for a Coulomb potential.
• 1927 – Charles Drummond Ellis (along with James Chadwick and colleagues) finally establish clearly that the beta decay spectrum is in fact continuous and not discrete, posing a problem that will later be solved by theorizing (and later discovering) the existence of the neutrino.
• 1927 – Walter Heitler uses Schrödinger's wave equation to show how two hydrogen atom wavefunctions join together, with plus, minus, and exchange terms, to form a covalent bond.
• 1927 – Robert Mulliken works, in coordination with Hund, to develop a molecular orbital theory where electrons are assigned to states that extend over an entire molecule and, in 1932, introduces many new molecular orbital terminologies, such as σ bond, π bond, and δ bond.
1927 – Eugene Wigner relates degeneracies of quantum states to irreducible representations of symmetry groups.

1927 – Hermann Klaus Hugo Weyl proves in collaboration with his student Fritz Peter a fundamental theorem in harmonic analysis—the Peter–Weyl theorem—relevant to group representations in quantum theory (including the complete reducibility of unitary representations of a compact topological group); introduces the Weyl quantization, and earlier, in 1918, introduces the concept of gauge and a gauge theory; later in 1935 he introduces and characterizes with Richard Bauer the concept of spinor in n-dimensions.

1928 – Linus Pauling outlines the nature of the chemical bond: uses Heitler's quantum mechanical covalent bond model to outline the quantum mechanical basis for all types of molecular structure and bonding and suggests that different types of bonds in molecules can become equalized by rapid shifting of electrons, a process called "resonance" (1931), such that resonance hybrids contain contributions from the different possible electronic configurations.

1928 – Friedrich Hund and Robert S. Mulliken introduce the concept of molecular orbitals.

1928 – Born and Vladimir Fock formulate and prove the adiabatic theorem, which states that a physical system shall remain in its instantaneous eigenstate if a given perturbation is acting on it slowly enough and if there is a gap between the eigenvalue and the rest of the Hamiltonian's spectrum.

1929 – Oskar Klein discovers the Klein paradox

1929 – Oskar Klein and Yoshio Nishina derive the Klein–Nishina cross section for high energy photon scattering by electrons

1929 – Sir Nevill Mott derives the Mott cross section for the Coulomb scattering of relativistic electrons

1929 – John Lennard-Jones introduces the linear combination of atomic orbitals approximation for the calculation of molecular orbitals.

1929 – Fritz Houtermans and Robert d'Escourt Atkinson propose that stars release energy by nuclear fusion.

1930–1939

1930 – Dirac hypothesizes the existence of the positron.

1930 – Dirac's textbook *The Principles of Quantum Mechanics* is published, becoming a standard reference book that is still used today.

1930 – Erich Hückel introduces the Hückel molecular orbital method, which expands on orbital theory to determine the energies of orbitals of pi electrons in conjugated hydrocarbon systems.
• 1930 – Fritz London explains van der Waals forces as due to the interacting fluctuating dipole moments between molecules

• 1930 – Pauli suggests in a famous letter that, in addition to electrons and protons, atoms also contain an extremely light neutral particle which he calls the "neutron." He suggests that this "neutron" is also emitted during beta decay and has simply not yet been observed. Later it is determined that this particle is actually the almost massless neutrino.

• 1931 – John Lennard-Jones proposes the Lennard-Jones interatomic potential

• 1931 – Walther Bothe and Herbert Becker find that if the very energetic alpha particles emitted from polonium fall on certain light elements, specifically beryllium, boron, or lithium, an unusually penetrating radiation is produced. At first this radiation is thought to be gamma radiation, although it is more penetrating than any gamma rays known, and the details of experimental results are very difficult to interpret on this basis. Some scientists begin to hypothesize the possible existence of another fundamental particle.

• 1931 – Erich Hückel redefines the property of aromaticity in a quantum mechanical context by introducing the 4n+2 rule, or Hückel's rule, which predicts whether an organic planar ring molecule will have aromatic properties.

• 1931 – Ernst Ruska creates the first electron microscope.

• 1931 – Ernest Lawrence creates the first cyclotron and founds the Radiation Laboratory, later the Lawrence Berkeley National Laboratory; in 1939 he awarded the Nobel Prize in Physics for his work on the cyclotron.

• 1932 – Irène Joliot-Curie and Frédéric Joliot show that if the unknown radiation generated by alpha particles falls on paraffin or any other hydrogen-containing compound, it ejects protons of very high energy. This is not in itself inconsistent with the proposed gamma ray nature of the new radiation, but detailed quantitative analysis of the data become increasingly difficult to reconcile with such a hypothesis.

• 1932 – James Chadwick performs a series of experiments showing that the gamma ray hypothesis for the unknown radiation produced by alpha particles is untenable, and that the new particles must be the neutrons hypothesized by Fermi.

• 1932 – Werner Heisenberg applies perturbation theory to the two-electron problem to show how resonance arising from electron exchange can explain exchange forces.

• 1932 – Mark Oliphant: Building upon the nuclear transmutation experiments of Ernest Rutherford done a few years earlier, observes fusion of light nuclei (hydrogen isotopes). The steps of the main cycle of nuclear fusion in stars are subsequently worked out by Hans Bethe over the next decade.

• 1932 – Carl D. Anderson experimentally proves the existence of the positron.
1933 – Following Chadwick's experiments, Fermi renames Pauli's "neutron" to neutrino to distinguish it from Chadwick's theory of the much more massive neutron.

1933 – Leó Szilárd first theorizes the concept of a nuclear chain reaction. He files a patent for his idea of a simple nuclear reactor the following year.

1934 – Fermi publishes a very successful model of beta decay in which neutrinos are produced.

1934 – Fermi studies the effects of bombarding uranium isotopes with neutrons.

1934 – N. N. Semyonov develops the total quantitative chain chemical reaction theory, later the basis of various high technologies using the incineration of gas mixtures. The idea is also used for the description of the nuclear reaction.

1934 – Irène Joliot-Curie and Frédéric Joliot-Curie discover artificial radioactivity and are jointly awarded the 1935 Nobel Prize in Chemistry.

1935 – Einstein, Boris Podolsky, and Nathan Rosen describe the EPR paradox which challenges the completeness of quantum mechanics as it was theorized up to that time. Assuming that local realism is valid, they demonstrated that there would need to be hidden parameters to explain how measuring the quantum state of one particle could influence the quantum state of another particle without apparent contact between them.

1935 - Schrödinger develops the Schrödinger's cat thought experiment. It illustrates what he saw as the problems of the Copenhagen interpretation of quantum mechanics if subatomic particles can be in two contradictory quantum states at once.

1935 – Hideki Yukawa formulates his hypothesis of the Yukawa potential and predicts the existence of the pion, stating that such a potential arises from the exchange of a massive scalar field, as it would be found in the field of the pion. Prior to Yukawa's paper, it was believed that the scalar fields of the fundamental forces necessitated massless particles.

1936 – Alexandru Proca publishes prior to Hideki Yukawa his relativistic quantum field equations for a massive vector meson of spin-1 as a basis for nuclear forces.

1936 – Garrett Birkhoff and John von Neumann introduce Quantum Logic in an attempt to reconcile the apparent inconsistency of classical, Boolean logic with the Heisenberg Uncertainty Principle of quantum mechanics as applied, for example, to the measurement of complementary (noncommuting) observables in quantum mechanics, such as position and momentum; current approaches to quantum logic involve noncommutative and non-associative many-valued logic.

1936 – Carl D. Anderson discovers muons while he is studying cosmic radiation.

1937 – Hermann Arthur Jahn and Edward Teller prove, using group theory, that non-linear degenerate molecules are unstable. The Jahn-Teller theorem essentially states that any non-linear molecule with a degenerate electronic ground state will undergo a geometrical distortion that removes that degeneracy.
because the distortion lowers the overall energy of the complex. The latter process is called the Jahn-Teller effect; this effect was recently considered also in relation to the superconductivity mechanism in YBCO and other high temperature superconductors. The details of the Jahn-Teller effect are presented with several examples and EPR data in the basic textbook by Abragam and Bleaney (1970).

- 1938 – Charles Coulson makes the first accurate calculation of a molecular orbital wavefunction with the hydrogen molecule.
- 1938 – Otto Hahn and his assistant Fritz Strassmann send a manuscript to Naturwissenschaften reporting they have detected the element barium after bombarding uranium with neutrons. Hahn calls this new phenomenon a 'bursting' of the uranium nucleus. Simultaneously, Hahn communicates these results to Lise Meitner. Meitner, and her nephew Otto Robert Frisch, correctly interpret these results as being a nuclear fission. Frisch confirms this experimentally on 13 January 1939.
- 1939 – Leó Szilárd and Fermi discover neutron multiplication in uranium, proving that a chain reaction is indeed possible.

1940–1949

- 1942 – Kan-Chang Wang first proposes the use of K-electron capture to experimentally detect neutrinos.
- 1942 – A team led by Enrico Fermi creates the first artificial self-sustaining nuclear chain reaction, called Chicago Pile-1, in a racquets court below the bleachers of Stagg Field at the University of Chicago on December 2, 1942.
- 1942 to 1946 – J. Robert Oppenheimer successfully leads the Manhattan Project, predicts quantum tunneling and proposes the Oppenheimer–Phillips process in nuclear fusion
- 1945 – the Manhattan Project produces the first nuclear fission explosion on July 16, 1945 in the Trinity test in New Mexico.
- 1945 – John Archibald Wheeler and Richard Feynman originate Wheeler–Feynman absorber theory, an interpretation of electrodynamics that supposes that elementary particles are not self-interacting.
- 1946 – Theodor V. Ionescu and Vasile Mihu report the construction of the first hydrogen maser by stimulated emission of radiation in molecular hydrogen.
- 1947 – Willis Lamb and Robert Retherford measure a small difference in energy between the energy levels $^2S_{1/2}$ and $^2P_{1/2}$ of the hydrogen atom, known as the Lamb shift.
- 1947 – George Rochester and Clifford Charles Butler publishes two cloud chamber photographs of cosmic ray-induced events, one showing what appears to be a neutral particle decaying into two charged pions, and one that appears to be a charged particle decaying into a charged pion and something neutral. The estimated mass of the new particles is very rough, about half a proton's mass. More examples of these "V-particles" were slow in coming, and they are soon given the name kaons.
1948 – Sin-Itiro Tomonaga and Julian Schwinger independently introduce perturbative renormalization as a method of correcting the original Lagrangian of a quantum field theory so as to eliminate a series of infinite terms that would otherwise result.

1948 – Richard Feynman states the path integral formulation of quantum mechanics.

1949 – Freeman Dyson determines the equivalence of two formulations of quantum electrodynamics: Feynman's diagrammatic path integral formulation and the operator method developed by Julian Schwinger and Tomonaga. A by-product of that demonstration is the invention of the Dyson series.

1950–1959

1951 – Clemens C. J. Roothaan and George G. Hall derive the Roothaan-Hall equations, putting rigorous molecular orbital methods on a firm basis.

1951 – Edward Teller, physicist and "father of the hydrogen bomb", and Stanislaw Ulam, mathematician, are reported to have written jointly in March 1951 a classified report on "Hydrodynamic Lenses and Radiation Mirrors" that results in the next step in the Manhattan Project.\[31\]

1951 and 1952 – At the Manhattan Project, the first planned fusion thermonuclear reaction experiment is carried out successfully in the Spring of 1951 at Eniwetok, based on the work of Edward Teller and Dr. Hans A. Bethe. The Los Alamos Laboratory proposes a date in November 1952 for a hydrogen bomb, full-scale test that is apparently carried out.

1951 – Felix Bloch and Edward Mills Purcell receive a shared Nobel Prize in Physics for their first observations of the quantum phenomenon of nuclear magnetic resonance previously reported in 1949. Purcell reports his contribution as Research in Nuclear Magnetism, and gives credit to his coworkers such as Herbert S. Gutowsky for their NMR contributions, as well as theoretical researchers of nuclear magnetism such as John Hasbrouck Van Vleck.

1952 – Albert W. Overhauser formulates a theory of dynamic nuclear polarization, also known as the Overhauser Effect; other contenders are the subsequent theory of Ionel Solomon reported in 1955 that includes the Solomon equations for the dynamics of coupled spins, and that of R. Kaiser in 1963. The general Overhauser effect is first demonstrated experimentally by T. R. Carver and Charles P. Slichter in 1953.

1952 – Donald A. Glaser creates the bubble chamber, which allows detection of electrically charged particles by surrounding them by a bubble. Properties of the particles such as momentum can be determined by studying of their helical paths. Glaser receives a Nobel prize in 1960 for his invention.

1953 – Charles H. Townes, collaborating with James P. Gordon, and Herbert J. Zeiger, builds the first ammonia maser; receives a Nobel prize in 1964 for his experimental success in producing coherent radiation by atoms and molecules.
• 1954 – Chen Ning Yang and Robert Mills derive a gauge theory for nonabelian groups, leading to the successful formulation of both electroweak unification and quantum chromodynamics.

• 1955 – Ionel Solomon develops the first nuclear magnetic resonance theory of magnetic dipole coupled nuclear spins and of the Nuclear Overhauser effect.

• 1955 and 1956 – Murray Gell-Mann and Kazuhiko Nishijima independently derive the Gell-Mann–Nishijima formula, which relates the baryon number, the strangeness, and the isospin of hadrons to the charge, eventually leading to the systematic categorization of hadrons and, ultimately, the Quark Model of hadron composition.

• 1956 – P. Kuroda predicts that self-sustaining nuclear chain reactions should occur in natural uranium deposits.

• 1956 – Chien-Shiung Wu carries out the Wu Experiment, which observes parity violation in cobalt-60 decay, showing that parity violation is present in the weak interaction.

• 1956 – Clyde L. Cowan and Frederick Reines experimentally prove the existence of the neutrino.

• 1957 – John Bardeen, Leon Cooper and John Robert Schrieffer propose their quantum BCS theory of low temperature superconductivity, for which they receive a Nobel prize in 1972. The theory represents superconductivity as a macroscopic quantum coherence phenomenon involving phonon coupled electron pairs with opposite spin.

• 1957 – William Alfred Fowler, Margaret Burbidge, Geoffrey Burbidge, and Fred Hoyle, in their 1957 paper *Synthesis of the Elements in Stars*, show that the abundances of essentially all but the lightest chemical elements can be explained by the process of nucleosynthesis in stars.

• 1957 – Hugh Everett formulates the many-worlds interpretation of quantum mechanics, which states that every possible quantum outcome is realized in divergent, non-communicating parallel universes in quantum superposition.


1960–1969

• 1961 – Clauss Jönsson performs Young’s double-slit experiment (1909) for the first time with particles other than photons by using electrons and with similar results, confirming that massive particles also behaved according to the wave–particle duality that is a fundamental principle of quantum field theory.

• 1961 – Anatole Abragam publishes the fundamental textbook on the quantum theory of Nuclear Magnetic Resonance entitled *The Principles of Nuclear Magnetism*;
• 1961 – Sheldon Lee Glashow extends the electroweak interaction models developed by Julian Schwinger by including a short range neutral current, the Z₀. The resulting symmetry structure that Glashow proposes, SU(2) X U(1), forms the basis of the accepted theory of the electroweak interactions.

• 1962 – Leon M. Lederman, Melvin Schwartz and Jack Steinberger show that more than one type of neutrino exists by detecting interactions of the muon neutrino (already hypothesised with the name "neutretto")

• 1962 – Murray Gell-Mann and Yuval Ne'eman independently classify the hadrons according to a system that Gell-Mann called the Eightfold Way, and which ultimately led to the quark model (1964) of hadron composition.

• 1962 – Jeffrey Goldstone, Yoichiro Nambu, Abdus Salam, and Steven Weinberg develop what is now known as Goldstone's Theorem: if there is a continuous symmetry transformation under which the Lagrangian is invariant, then either the vacuum state is also invariant under the transformation, or there must be spinless particles of zero mass, thereafter called Nambu-Goldstone bosons.

• 1962 to 1973 – Brian David Josephson, predicts correctly the quantum tunneling effect involving superconducting currents while he is a PhD student under the supervision of Professor Brian Pippard at the Royal Society Mond Laboratory in Cambridge, UK; subsequently, in 1964, he applies his theory to coupled superconductors. The effect is later demonstrated experimentally at Bell Labs in the USA. For his important quantum discovery he is awarded the Nobel Prize in Physics in 1973.

• 1963 – Eugene P. Wigner lays the foundation for the theory of symmetries in quantum mechanics as well as for basic research into the structure of the atomic nucleus; makes important "contributions to the theory of the atomic nucleus and the elementary particles, particularly through the discovery and application of fundamental symmetry principles"; he shares half of his Nobel prize in Physics with Maria Goeppert-Mayer and J. Hans D. Jensen.

• 1963 – Maria Goeppert Mayer and J. Hans D. Jensen share with Eugene P. Wigner half of the Nobel Prize in Physics in 1963 "for their discoveries concerning nuclear shell structure theory".

• 1963 – Nicola Cabibbo develops the mathematical matrix by which the first two (and ultimately three) generations of quarks can be predicted.

• 1964 – Murray Gell-Mann and George Zweig independently propose the quark model of hadrons, predicting the arbitrarily named up, down, and strange quarks. Gell-Mann is credited with coining the term quark, which he found in James Joyce's book *Finnegans Wake*.

• 1964 – François Englert, Robert Brout, Peter Higgs, Gerald Guralnik, C. R. Hagen, and Tom Kibble postulate that a fundamental quantum field, now called the Higgs field, permeates space and, by way of the Higgs mechanism, provides mass to all the elementary subatomic particles that interact with it. While the Higgs field is postulated to confer mass on quarks and leptons, it represents only a tiny portion of the masses of other subatomic particles, such as protons and neutrons. In these, gluons that bind quarks
together confer most of the particle mass. The result is obtained independently by three groups: François Englert and Robert Brout; Peter Higgs, working from the ideas of Philip Anderson; and Gerald Guralnik, C. R. Hagen, and Tom Kibble.

- 1964 – Sheldon Lee Glashow and James Bjorken predict the existence of the charm quark. The addition is proposed because it allows for a better description of the weak interaction (the mechanism that allows quarks and other particles to decay), equalizes the number of known quarks with the number of known leptons, and implies a mass formula that correctly reproduced the masses of the known mesons.

- 1964 – John Stewart Bell puts forth Bell’s theorem, which used testable inequality relations to show the flaws in the earlier Einstein–Podolsky–Rosen paradox and prove that no physical theory of local hidden variables can ever reproduce all of the predictions of quantum mechanics. This inaugurated the study of quantum entanglement, the phenomenon in which separate particles share the same quantum state despite being at a distance from each other.

- 1964 – Nikolai G. Basov and Aleksandr M. Prokhorov share the Nobel Prize in Physics in 1964 for, respectively, semiconductor lasers and Quantum Electronics; they also share the prize with Charles Hard Townes, the inventor of the ammonium maser.

- 1967 – Steven Weinberg and Abdus Salam publish a paper in which he describes Yang–Mills theory using the SU(2) X U(1) supersymmetry group, thereby yielding a mass for the W particle of the weak interaction via spontaneous symmetry breaking.

- 1968 – Stanford University: Deep inelastic scattering experiments at the Stanford Linear Accelerator Center (SLAC) show that the proton contains much smaller, point-like objects and is therefore not an elementary particle. Physicists at the time are reluctant to identify these objects with quarks, instead calling them partons — a term coined by Richard Feynman. The objects that are observed at SLAC will later be identified as up and down quarks. Nevertheless, "parton" remains in use as a collective term for the constituents of hadrons (quarks, antiquarks, and gluons). The existence of the strange quark is indirectly validated by the SLAC’s scattering experiments: not only is it a necessary component of Gell-Mann and Zweig's three-quark model, but it provides an explanation for the kaon (K) and pion (π) hadrons discovered in cosmic rays in 1947.

- 1969 to 1977 – Sir Nevill Mott and Philip Warren Anderson publish quantum theories for electrons in non-crystalline solids, such as glasses and amorphous semiconductors; receive in 1977 a Nobel prize in Physics for their investigations into the electronic structure of magnetic and disordered systems, which allow for the development of electronic switching and memory devices in computers. The prize is shared with John Hasbrouck Van Vleck for his contributions to the understanding of the behavior of electrons in magnetic solids; he established the fundamentals of the quantum mechanical theory of magnetism and the crystal field theory (chemical bonding in metal complexes) and is regarded as the Father of modern Magnetism.
• 1969 and 1970 – Theodor V. Ionescu, Radu Pârvan and I.C. Baianu observe and report quantum amplified stimulation of electromagnetic radiation in hot deuterium plasmas in a longitudinal magnetic field; publish a quantum theory of the amplified coherent emission of radiowaves and microwaves by focused electron beams coupled to ions in hot plasmas.

• 1970 – Glashow, John Iliopoulos and Luciano Maiani predict the charmed quark that is subsequently found experimentally and share a Nobel prize for their theoretical prediction.

1971–1979

• 1971 – Martinus J. G. Veltman and Gerardus ’t Hooft show that, if the symmetries of Yang–Mills theory are broken according to the method suggested by Peter Higgs, then Yang–Mills theory can be renormalized. The renormalization of Yang–Mills Theory predicts the existence of a massless particle, called the gluon, which could explain the nuclear strong force. It also explains how the particles of the weak interaction, the W and Z bosons, obtain their mass via spontaneous symmetry breaking and the Yukawa interaction.

• 1972 – Francis Perrin discovers "natural nuclear fission reactors" in uranium deposits in Oklo, Gabon, where analysis of isotope ratios demonstrate that self-sustaining, nuclear chain reactions have occurred. The conditions under which a natural nuclear reactor could exist were predicted in 1956 by P. Kuroda.

• 1973 – Frank Anthony Wilczek discover the quark asymptotic freedom in the theory of strong interactions; receives the Lorentz Medal in 2002, and the Nobel Prize in Physics in 2004 for his discovery and his subsequent contributions to quantum chromodynamics.

• 1973 – Makoto Kobayashi and Toshihide Maskawa note that the experimental observation of CP violation can be explained if an additional pair of quarks exist. The two new quarks are eventually named top and bottom.

• 1973 – Peter Mansfield formulates the physical theory of Nuclear magnetic resonance imaging (NMRI)

• 1974 – Pier Giorgio Merli performs Young's double-slit experiment (1909) using a single electron with similar results, confirming the existence of quantum fields for massive particles.

• 1974 – Burton Richter and Samuel Ting: Charm quarks are produced almost simultaneously by two teams in November 1974 — one at SLAC under Burton Richter, and one at Brookhaven National Laboratory under Samuel Ting. The charm quarks are observed bound with charm antiquarks in mesons. The two discovering parties independently assign the discovered meson two different symbols, J and ψ; thus, it becomes formally known as the J/ψ meson. The discovery finally convinces the physics community of the quark model's validity.

• 1975 – Martin Lewis Perl, with his colleagues at the SLAC–LBL group, detects the tau in a series of experiments between 1974 and 1977.
Leon Lederman observes the bottom quark with his team at Fermilab. This discovery is a strong indicator of the top quark's existence: without the top quark, the bottom quark would be without a partner that is required by the mathematics of the theory.

Ilya Prigogine develops non-equilibrium, irreversible thermodynamics and quantum operator theory, especially the time superoperator theory; he is awarded the Nobel Prize in Chemistry in 1977 "for his contributions to non-equilibrium thermodynamics, particularly the theory of dissipative structures".

Pyotr Kapitsa observes new phenomena in hot deuterium plasmas excited by very high power microwaves in attempts to obtain controlled thermonuclear fusion reactions in such plasmas placed in longitudinal magnetic fields, using a novel and low-cost design of thermonuclear reactor, similar in concept to that reported by Theodor V. Ionescu et al. in 1969. Receives a Nobel prize for early low temperature physics experiments on helium superfluidity carried out in 1937 at the Cavendish Laboratory in Cambridge, UK, and discusses his 1977 thermonuclear reactor results in his Nobel lecture on December 8, 1978.

Kenneth A. Rubinson and coworkers, at the Cavendish Laboratory, observe ferromagnetic spin wave resonant excite journals (FSWR) in locally anisotropic, FENiPB metallic glasses and interpret the observations in terms of two-magnon dispersion and a spin exchange Hamiltonian, similar in form to that of a Heisenberg ferromagnet.

1980–1999

Alain Aspect verifies experimentally the quantum entanglement hypothesis; his Bell test experiments provide strong evidence that a quantum event at one location can affect an event at another location without any obvious mechanism for communication between the two locations. This remarkable result confirmed the experimental verification of quantum entanglement by J.F.Clauser. and. S.J.Freedman in 1972.

Tokamak Fusion Test Reactor (TFTR) at PPPL, Princeton, USA: Operated since 1982, produces 10.7MW of controlled fusion power for only 0.21s in 1994 by using T-D nuclear fusion in a tokamak reactor with "a toroidal 6T magnetic field for plasma confinement, a 3MA plasma current and an electron density of 1.0×10^{20} m^{-3} of 13.5 keV"

Carlo Rubbia and Simon van der Meer, at the Super Proton Synchrotron, see unambiguous signals of W particles in January. The actual experiments are called UA1 (led by Rubbia) and UA2 (led by Peter Jenni), and are the collaborative effort of many people. Simon van der Meer is the driving force on the use of the accelerator. UA1 and UA2 find the Z particle a few months later, in May 1983.

The largest and most powerful experimental nuclear fusion tokamak reactor in the world, Joint European Torus (JET) begins operation at Culham Facility in UK; operates with T-D plasma pulses and has a reported gain factor $Q$ of 0.7 in 2009, with an input of 40MW for plasma heating, and a
2800-ton iron magnet for confinement; in 1997 in a tritium-deuterium experiment JET produces 16 MW of fusion power, a total of 22 MJ of fusion, energy and a steady fusion power of 4 MW which is maintained for 4 seconds.

- 1985 to 2010 – The JT-60 (Japan Torus) begins operation in 1985 with an experimental D-D nuclear fusion tokamak similar to the JET; in 2010 JT-60 holds the record for the highest value of the fusion triple product achieved: $1.77 \times 10^{28} \text{K}\cdot\text{s}\cdot\text{m}^{-3} = 1.53 \times 10^{21} \text{keV}\cdot\text{s}\cdot\text{m}^{-3}$; JT-60 claims it would have an equivalent energy gain factor, $Q$, of 1.25 if it were operated with a T-D plasma instead of the D-D plasma, and on May 9, 2006 attains a fusion hold time of 28.6 s in full operation; moreover, a high-power microwave gyrotron construction is completed that is capable of $1.5 \text{MW}$ output for 1 s, thus meeting the conditions for the planned ITER, large-scale nuclear fusion reactor. JT-60 is disassembled in 2010 to be upgraded to a more powerful nuclear fusion reactor—the JT-60SA—by using niobium-titanium superconducting coils for the magnet confining the ultra-hot D-D plasma.


- 1986 – Vladimir Gershonovich Drinfeld introduces the concept of quantum groups as Hopf algebras in his seminal address on quantum theory at the International Congress of Mathematicians, and also connects them to the study of the Yang–Baxter equation, which is a necessary condition for the solvability of statistical mechanics models; he also generalizes Hopf algebras to quasi-Hopf algebras, and introduces the study of Drinfeld twists, which can be used to factorize the $R$-matrix corresponding to the solution of the Yang–Baxter equation associated with a quasitriangular Hopf algebra.


- 1991 – Richard R. Ernst develops two-dimensional nuclear magnetic resonance spectroscopy (2D-FT NMRS) for small molecules in solution and is awarded the Nobel Prize in Chemistry in 1991 "for his contributions to the development of the methodology of high resolution nuclear magnetic resonance (NMR) spectroscopy."

- 1977 to 1995 – The top quark is finally observed by a team at Fermilab after an 18-year search. It has a mass much greater than had been previously expected — almost as great as a gold atom.

- 1995 – Eric Cornell, Carl Wieman and Wolfgang Ketterle and co-workers at JILA create the first "pure" Bose–Einstein condensate. They do this by cooling a dilute vapor consisting of approximately two thousand rubidium-87 atoms to below 170 nK using a combination of laser cooling and magnetic evaporative cooling. About four months later, an independent effort led by Wolfgang Ketterle
at MIT creates a condensate made of sodium-23. Ketterle's condensate has about a hundred times more atoms, allowing him to obtain several important results such as the observation of quantum mechanical interference between two different condensates.

- 1998 – The Super-Kamiokande (Japan) detector facility reports experimental evidence for neutrino oscillations, implying that at least one neutrino has mass.

- 1999 to 2013 – NSTX—The National Spherical Torus Experiment at PPPL, Princeton, USA launches a nuclear fusion project on February 12, 1999 for "an innovative magnetic fusion device that was constructed by the Princeton Plasma Physics Laboratory (PPPL) in collaboration with the Oak Ridge National Laboratory, Columbia University, and the University of Washington at Seattle"; NSTX is being used to study the physics principles of spherically shaped plasmas.

21st century

- 2000 – scientists at European Organization for Nuclear Research (CERN) publish experimental results in which they claim to have observed indirect evidence of the existence of a quark–gluon plasma, which they call a "new state of matter."

- 2001 – the Sudbury Neutrino Observatory (Canada) confirm the existence of neutrino oscillations. Lene Hau stops a beam of light completely in a Bose–Einstein condensate.

- 2002 – Leonid Vainerman organizes a meeting at Strasbourg of theoretical physicists and mathematicians focused on quantum group and quantum groupoid applications in quantum theories; the proceedings of the meeting are published in 2003 in a book edited by the meeting organizer.

- 2003 – Sir Anthony James Leggett receives the 2003 Nobel Prize in Physics for pioneering contributions to the quantum theory of superconductors, and superfluids such as Helium-3, shared with V. L. Ginzburg and A. A. Abrikosov.

- 2005 – the RHIC accelerator of Brookhaven National Laboratory generates a quark–gluon fluid, perhaps the quark–gluon plasma

- 2007 to 2010 – Charles Pence Slichter is awarded the National Medal of Science in 2007 for his studies of Nuclear Magnetic Resonance in Solids, and especially his NMR Studies of High-Temperature Superconductors.

- 2007 to 2010 – Alain Aspect, Anton Zeilinger and John Clauser present progress with the resolution of the non-locality aspect of quantum theory and in 2010 are awarded the Wolf Prize in Physics, together with Anton Zeilinger and John Clauser.

- 2009 - Aaron D. O'Connell invents the first quantum machine, applying quantum mechanics to a macroscopic object just large enough to be seen by the naked eye, which is able to vibrate a small amount and large amount simultaneously.
• 2011 - Zachary Dutton demonstrates how photons can co-exist in superconductors. "Direct Observation of Coherent Population Trapping in a Superconducting Artificial Atom",

• 2012 - The existence of Higgs boson was confirmed by the ATLAS and CMS collaborations based on proton-proton collisions in the LHC at CERN. Peter Higgs and François Englert were awarded the 2013 Nobel Prize in Physics for their theoretical predictions.

• 2014 – Scientists transfer data by quantum teleportation over a distance of 10 feet with zero percent error rate, a vital step towards a quantum internet.

**Timeline of Christianity**

**Apostolic Age**

Shortly after the death and resurrection of Jesus (Nisan 14 or 15), the Jerusalem church is founded as the first Christian church with about 120 Jews and Jewish Proselytes (Acts 1:15), followed by Pentecost (Sivan 6), the Ananias and Sapphira incident, Pharisee Gamaliel's defense of the Apostles (5:34-39), the stoning of Saint Stephen (see also Persecution of Christians) and the subsequent dispersion of the Apostles (7:54-8:8, also Mark 16:20) which leads to the baptism of Simon Magus in Samaria (8:9-24), and also an Ethiopian eunuch (8:26-40). Paul's "Road to Damascus" conversion to "Apostle to the Gentiles" is first recorded in 9:13-16, cf. Gal 1:11-24. Peter baptizes the Roman Centurion Cornelius, who is traditionally considered the first Gentile convert to Christianity (10). The Antioch church is founded, where the term Christian was first used (11:26).

• 37-41 Crisis under Caligula, proposed as the first open break between Rome and the Jews

• before 44 Epistle of James is written by James the Great

• 44? Saint James the Great: According to a medieval tradition, on 2 January of the year AD 40, the Virgin Mary appeared to James on a pillar on the bank of the Ebro River at Caesaraugusta, while he was preaching the Gospel in Spain. There is no factual evidence of this. Following that vision, St James returned to Judea, where he was beheaded by King Herod Agrippa I in the year 44 during a Passover (Nisan 15) (Acts 12:1-3).

• 44 Death of Herod Agrippa I (JA19.8.2, Acts 12:20-23)

• 44-46? Theudas beheaded by Procurator Cuspius Fadus for saying he would part the Jordan river (like Moses and the Red Sea or Joshua and the Jordan) (JA20.5.1, Acts 5:36-37 places it before the Census of Quirinius)
• 45-49? Mission of Barnabas and Paul, (Acts 13:1-14:28) to Cyprus, Pisidian Antioch, Iconium, Lystra and Derbe (there they were called "gods ... in human form"), then return to Syrian Antioch: Map1

• 47 The Church of the East is created by Saint Thomas

• 48-100 Herod Agrippa II appointed King of the Jews by Claudius, seventh and last of the Herodians

• 49 "Since the Jews constantly made disturbances at the instigation of Chrestus, he [Claudius] expelled them from Rome." (referenced in Acts 18:2)

• 50 Passover riot in Jerusalem, 20,000-30,000 killed (JA20.5.3,JW2.12.1)

• 50? Council of Jerusalem and the "Apostolic Decree" of Acts 15:1-35, same as Galatians 2:1-10?, which is followed by the Incident at Antioch at which Paul publicly accuses Peter of "Judaizing" (2:11-21); see also Circumcision controversy in early Christianity

• 50-53? Paul's 2nd mission (Acts 15:36-18:22), split with Barnabas, to Phrygia, Galatia, Macedonia, Philippia, Thessalonica, Berea, Athens, Corinth, "he had his hair cut off at Cenchrea because of a vow he had taken", then return to Antioch; 1 Thessalonians, Galatians written? Map2. Lydia of Thyatira, a seller of purple, becomes the first European Christian convert (Acts 16:11-15)

• 51-52 or 52-53 Proconsuls of Gallio according to an inscription, only fixed date in chronology of Paul

• 52, November 21 St. Thomas the Apostle lands in India. Establishes churches at Kodungalloor, Palayoor, Paraur, Kottakkav, Kokkamangalam, Nilakkal, Niranam and Kollam

• 53-57? Paul's 3rd mission, (Acts 18:23-22:30), to Galatia, Phrygia, Corinth, Ephesus, Macedonia, Greece, and Jerusalem where James the Just challenges him about rumor of teaching antinomianism (21:21); he addresses a crowd in their language (most likely Aramaic); Romans, 1 Corinthians, 2 Corinthians, Philippians written? Map3

• 55? "Egyptian prophet" (allusion to Moses) and 30,000 unarmed Jews doing The Exodus reenactment massacred by Procurator Antonius Felix (JW2.13.5, JA20.8.6, Acts 21:38)

• 58? Paul arrested, accused of being a revolutionary, "ringleader of the sect of the Nazarenes", teaching resurrection of the dead, imprisoned in Caesarea (Acts 23-26)

• 59? Paul shipwrecked on Malta, called a god (Acts 28:6)

• 60? Paul in Rome: greeted by many "brothers", three days later calls together the Jewish leaders, who hadn't received any word from Judea about him but were curious about "this sect" which everywhere is spoken against; he tries to convince them from the "law and prophets", with partial success – said the Gentiles would listen, and spends two years proclaiming the Kingdom of God and teaching "the Lord Jesus Christ" (Acts 28:15-31); Epistle to Philemon written?

• 60-64? early date for writing of 1 Peter (Peter as author)

• before 62 Epistle of James if written by James the Just
• 62 James the Just stoned to death for law transgression by High Priest Ananus ben Artanus; popular opinion against act results in Ananus being deposed by new procurator Lucceius Albinus (JA20.9.1)
• 63-107? Simeon, 2nd Bishop of Jerusalem, crucified under Trajan
• 64-68 after July 18 Great Fire of Rome; Nero blames and persecutes the Christians (or Chrestians), possibly the earliest mention of Christians by that name, in Rome; see also Tacitus on Jesus; Paul beheaded? (Col 1:24,Eph 3:13,2 Tim 4:6-8,1Clem 5:5-7), Peter crucified upside-down? (Jn 21:18,1 Pet 5:13,Tertullian's Prescription Against Heretics chapter XXXVI,Eusebius' Church History Book III chapter I), "...a vast multitude, were convicted, not so much of the crime of incendiarism as of hatred of the human race. And in their deaths they were made the subjects of sport; for they were wrapped in the hides of wild beasts and torn to pieces by dogs, or nailed to crosses, or set on fire, and when day declined, were burned to serve for nocturnal lights." (Annals (Tacitus) XV.44)
• 64/67(?)-76/79(?) Pope Linus succeeds Peter as Episcopus Romanus (Bishop of Rome)
• 64 Epistle to the Hebrews written
• 65? Q document, a hypothetical Greek text thought by many critical scholars to have been used in writing of Matthew and Luke
• 66-73 First Jewish–Roman War: destruction of Herod's Temple and end of Judaism according to Supersessionism; Qumran community (site of Dead Sea Scrolls found in 1947) destroyed
• 70(+/−10)? Gospel of Mark, written in Rome, by Peter's interpreter (1 Peter 5:13), original ending apparently lost, endings added c. 400, see Mark 16
• 70? Signs Gospel written, hypothetical Greek text used in Gospel of John to prove Jesus is the Messiah
• 70-100? Additional Pauline Epistles
• 70-200? Gospel of Thomas, Jewish Christian Gospels: Gospel of the Ebionites, Gospel of the Hebrews, Gospel of the Nazarenes
• 72, July 3 Martyrdom of St. Thomas the Apostle at Chinnamala, Mylapore, Chennai (Tamil Nadu)
• 76/79(?)-88 Pope Anacletus: first Greek Pope, who succeeds Linus as Episcopus Romanus (Bishop of Rome)
• 80(+/−20) Didache written
• 80(+/−20)? Gospel of Matthew, based on Mark and Q, most popular in Early Christianity
• 80(+/−20)? Gospel of Luke, based on Mark and Q, also Acts of the Apostles by same author
• 80(+/−20)? Pastoral Epistles written (possible post-Pauline authorship)
• 88-101? Clement, fourth Bishop of Rome: wrote Letter of the Romans to the Corinthians (Apostolic Fathers)
• 90? Council of Jamnia of Judaism (disputed); Domitian applies the Fiscus Judaicus tax even to those who merely "lived like Jews"

• 90(+/-10)? late date for writing of 1 Peter (associate of Peter as author)

• 94 Testimonium Flavianum, disputed section of Jewish Antiquities by Josephus in Aramaic, translated to Koine Greek

• 95(+/-30)? Gospel of John and Epistles of John

• 95(+/-10)? Book of Revelation written, by John (son of Zebedee) and/or a disciple of his

• 96 Nerva modifies the Fiscus Judaicus, from then on, practising Jews pay the tax, Christians do not

• 98-117? Ignatius, third Bishop of Antioch, fed to the lions in the Roman Colosseum, advocated the Bishop (Eph 6:1, Mag 2:1,6:1,7:1,13:2, Tr 3:1, Smy 8:1,9:1), rejected Sabbath on Saturday in favor of "The Lord's Day" (Sunday). (Mag 9.1), rejected Judaizing (Mag 10.3), first recorded use of the term catholic (Smy 8:2).

• 100(+/-30)? Epistle of Barnabas (Apostolic Fathers)

• 100(+/-25)? Epistle of James if written by author other than James the Just or James the Great

• 100(+/-10)? Epistle of Jude written, probably by doubting relative of Jesus (Mark 6,3), rejected by some early Christians due to its reference to apocryphal Book of Enoch (v14)

Ante-Nicene Period

• 100–150? Apocryphon of James, Gospel of Mary Magdalene, Gospel of James, Infancy Gospel of Thomas, Secret Gospel of Mark (Complete Gospels, published by Jesus Seminar)

• 110–130? Papias, bishop of Hierapolis, writes "Expositions of the Sayings of the Lord", lost, widely quoted (Apostolic Fathers)

• 110 - Ignatius of Antioch writes to the Smyrnaeans that the Christian church is katholikos ("universal")

• 110–160? Polycarp, bishop of Smyrna, Letter to the Philippians, (Apostolic Fathers)

• 112 - Pliny reports rapid growth of Christianity in Bithynia

• 120? Rabbi Tarfon advocates burning the Gospels

• 125(+/-5)? 2 Peter written, not accepted into canon until early 400s, drew upon Epistle of Jude, "catholic" epistle, Pastoral Epistles written

• 125? Rylands Library Papyrus P52, oldest extant NT fragment, p. 1935, parts of Jn18:31-33,37-38

• 130-250? "Christian Apologists" writings against Roman religion: Justin Martyr, Athenagoras, Apology of Aristides, Theophilus of Antioch, Tatian, Quadratus, Melito of Sardis, Apollinaris Claudius, Marcus Minucius Felix, Arnobius, Epistle to Diognetus
132–135 Bar Kokhba's revolt: final Jewish revolt, Judea and Jerusalem erased from maps, region renamed Syria Palæstina (the term *Palestine* was originally coined by Herodotus), Jerusalem renamed Aelia Capitolina

142–144? Marcion of Sinope: bishop according to *Catholic Encyclopedia*, goes to Rome, possibly to buy the bishopric of Rome, upon rejection forms his own church in Rome, later called Marcionism, rejected Old Testament, decreed canon of one Gospel, one *Apostolicon* (10 Letters of Paul) and one *Antithesis* which contrasted the Old Testament with the New Testament, cited Western text-type, see also Expounding of the Law#Antithesis of the Law

150? "Western Revisor" adds/subtracts from original Acts to produce Western version which is 10% larger and found in Papyrus P29,38,48 and Codex Bezae (D)

150 - Gospel reaches Portugal and Morocco

150? Valentinius (most famous Christian Gnostic, according to Tertullian) narrowly loses election for Bishop of Rome

150(+-10)? *The Shepherd of Hermas*, written in Rome (Apostolic Fathers)

150–200? Other Gospels: Gospel of the Saviour, Gospel of Peter, Oxyrhynchus Gospels, Dialogue of the Saviour

155? Montanus claims to be the Paraclete ("Counselor") of John 14:16

160? Martyrdom of Polycarp (Apostolic Fathers)

166 - Bishop Soter writes that the number of Christians has surpassed the Jews

167 - At the request of Lucius of Britain, missionaries Fuganus (or Phagan) and Duvianus (or Deruvian) were sent by Pope Eleuterus to convert the Britons to Christianity

170? Dionysius, bishop of Corinth claimed Christians were changing and faking his own letters just as [he knew] they had changed the Gospels (Eusebius' EH 4 c.23 v.12; Ante-Nicene Fathers,v.8)

170? Tatian produces "Diatessaron" (Harmony) by blending 4 "Western" text-type Gospels into 1

170? Symmachus the Ebionite writes new Greek translation of Hebrew Bible

174 - First Christians reported in Austria

177 - Persecution in Lyon, martyrdom of Blandina

180? Hegesippus


185–350? Muratorian fragment, 1st extant canon for New Testament after Marcion?, written in Rome by Hippolytus?, excludes Hebrews, James, 1-2 Peter, 3 John; includes Wisdom of Solomon, Apocalypse of Peter
• 186? Saint Apollonius: used the term *catholic* in reference to 1 John

• 188–231 Saint Demetrius: bishop of Alexandria, condemned Origen

• 189–198 Pope Victor I: 1st Latin Pope, excommunicated Eastern churches that continued to observe Easter on Nisan 14 Quartodeciman

• 190 - Pataenus of Alexandria goes to India in response to an appeal for Christian teachers


• 196 - Bar Daisan writes of Christians among the Parthians, Bactrians (Kushans), and other peoples in the Persian Empire

• 197 - Tertullian writes that Christianity had penetrated all ranks of society in North Africa

• 199–217? Caius, presbyter of Rome, wrote "Dialogue against Proclus" in *Ante-Nicene Fathers*, rejected Revelation, said to be by Gnostic Cerinthus, see also Alogi

• 200 - First Christians are reported in Switzerland and Belgium

• 199–217? Caius, presbyter of Rome, wrote "Dialogue against Proclus" in Ante-Nicene Fathers, rejected Revelation, said to be by Gnostic Cerinthus, see also Alogi


• 200? Sextus Julius Africanus

• 200? Antipope Natalius, rival bishop of Rome, according to Eusebius's EH5.28.8-12, quoting the *Little Labyrinth* of Hippolytus, after being "scourged all night by the holy angels", covered in ash, dressed in sackcloth, and "after some difficulty", tearfully submitted to Pope Zephyrinus

• 202 - Roman Emperor Severus issues an edict forbidding conversion to Christianity

• 206 - Abgar, King of Edessa, embraces the Christian faith

• 208 - Tertullian writes that Christ has followers on the far side of the Roman wall in Britain where Roman legions have not yet penetrated

• 217–236 Antipope Hippolytus, *Logos* sect? Later dispute settled and considered martyr, Roman canon

• 218–258 Cyprian, Bishop of Carthage, cited "Western" NT text-type, claimed Christians were freely forging his letters to discredit him (Ante-Nicene Fathers)


• 220?–340? Codex Tchacos, manuscript containing a copy of the Gospel of Judas, is written

225? Papyrus 45: 1st Chester Beatty Papyri, Gospels (Caesarean text-type, mixed), Acts (Alexandrian text-type)

235–238 Maximinus Thrax: emperor of Rome, ends Christian schism in Rome by deporting Pope Pontian and Antipope Hippolytus to Sardinia, where they soon die

241 - Mani begins to preach in Seleucia-Ctesiphon in what is now Iraq

248–264 Dionysius, Patriarch of Alexandria see also List of Patriarchs of Alexandria

250 - Denis (or Denys or Dionysius) is sent from Rome along with six other missionaries to establish the church in Paris

250? Apostolic Constitutions, Liturgy of St James, Old Roman Symbol, Clementine literature


250? Papyrus 72: Bodmer 5-11+, pub. 1959, "Alexandrian" text-type: Nativity of Mary; 3Cor; Odes of Solomon 11; Jude 1-25; Melito's Homily on Passover; Hymn fragment; Apology of Phileas; Ps33,34; 1Pt1:1-5:14; 2Pt1:1-3:18

250? Origen, Jesus and God one substance, adopted at First Council of Nicaea in 325, compiled Hexapla; cites Alexandrian, Caesarean text-type; Eusebius claimed Origen castrated himself for Christ due to Mt19:12 (EH6.8.1-3)

251–424? Synods of Carthage

251–258 Antipope Novatian decreed no forgiveness for sins after baptism (An antipope was an individual whose claim to the papacy was either rejected by the Church at the time or later recognized as invalid.)

254–257 Pope Stephen I: major schism over rebaptizing heretics and apostates

258 "Valerian's Massacre": Roman emperor issues edict to execute immediately all Christian Bishops, Presbyters, and Deacons, including Pope Sixtus II, Antipope Novatian, Cyprian of Carthage (CE: Valerian, Schaff's History Vol 2 Chap 2 § 22)

264–269 Synods of Antioch: condemned Paul of Samosata, Bishop of Antioch, founder of Adoptionism (Jesus was human until Holy Spirit descended at his baptism), also condemned term homoousios adopted at Nicaea

265 Gregory Thaumaturgus (Ante-Nicene Fathers)]

270 - Death of Gregory Thaumaturgus, Christian leader in Pontus. It was said that when Gregory became "bishop" there were only 17 Christians in Pontus while at his death thirty years later there were only 17 non-Christians.
• 270? Anthony begins monastic movement
• 275? Papyrus 47: 3rd Chester Beatty, ~Sinaiticus, Rev9:10-11:3,5-16:15,17-17:2
• 276 Mani (prophet), crucified, founder of the dualistic Manichaean sect in Persia
• 280 - First rural churches emerge in northern Italy; Christianity is no longer exclusively in urban areas
• 287 - Maurice from Egypt is killed at Agauno, Switzerland for refusing to sacrifice to pagan divinities
• 290–345? St Pachomius, founder of Christian monasticism
• 296–304 Pope Marcellinus, offered pagan sacrifices for Diocletian, later repented. Name in Martyrology of Bede
• 300 - First Christians reported in Greater Khorasan; an estimated 10% of the world’s population is now Christian; parts of the Bible are available in 10 different languages
• 301 – Armenia is the first kingdom in history to adopt Christianity as state religion
• 303–312 Diocletian’s Massacre of Christians, includes burning of scriptures (EH 8.2)
• 303 Saint George, patron saint of Georgia, England and other states
• 304? Victorinus, bishop of Pettau
• 304? Pope Marcellinus, having repented from his previous defection, suffers martyrdom with several companions
• 306 Synod of Elvira prohibits relations between Christians and Jews
• 310 Maxentius deports Pope Eusebius and Heraclius to Sicily (relapse controversy)
• 312 Lucian of Antioch, founder of School of Antioch, martyred
• 312 Vision of Constantine: while gazing into the sun he sees a cross with the words by this sign conquer, see also Labarum, he was later called the 13th Apostle and Equal-to-apostles
• 313 Edict of Milan: Constantine and Licinius end persecution, establish toleration of Christianity
• 313? Lateran Palace given to Pope Miltiades for residence by Constantine
• 313? Traditional date for founding of the Brotherhood of the Holy Sepulchre
• 314 King Urnayr of Caucasian Albania adopts Christianity as official religion
• 314 Catholic Council of Arles, called by Constantine against Donatist schism to confirm the Council of Rome in 313
• 314–340? Eusebius, bishop of Caesarea, church historian, cited Caesarean text-type, wrote *Ecclesiastical History* in 325
• 317? Lactantius
321 Constantine decrees Sunday as state "day of rest" (CJ3.12.2), see also Sol Invictus

**First Seven Ecumenical Councils**

Constantine called the First Council of Nicaea in 325 to unify Christology, also called the first great Christian council by Jerome, the first ecumenical, decreed the Original Nicene Creed, but rejected by Nontrinitarians such as Arius, Theonas, Secundus of Ptolemais, Eusebius of Nicomedia, and Theognis of Nicaea who were excommunicated, also addressed Easter controversy and passed 20 Canon laws such as Canon VII which granted special recognition to Jerusalem.

- 325, 20 May–19 June: The First Council of Nicaea
- 325 The Kingdom of Aksum (Modern Ethiopia and Eritrea) declares Christianity as the official state religion, becoming the 2nd country to do so
- 325 Church of the Nativity in Bethlehem, ordered built by Constantine
- 326, November 18 Pope Sylvester I consecrates the Basilica of St. Peter built by Constantine the Great over the tomb of the Apostle
- 330 Old Church of the Holy Apostles, dedicated by Constantine
- 330, May 11: Constantinople solemnly inaugurated. Constantine moves the capital of the Roman Empire to Byzantium, renaming it New Rome
- 331 Constantine commissions Eusebius to deliver 50 Bibles for the Church of Constantinople
- 335 Council in Jerusalem reverses Nicaea's condemnation of Arius, consecrates Jerusalem Church of the Holy Sepulchre
- 337? Mirian III of Iberia (present-day Georgia) adopts Christianity.
- 337, May 22: Constantine the Great dies (baptized shortly prior to his death)
- 341–379 Shapur II's persecution of Persian Christians
- 343? Catholic Council of Serdica, canons confirmed by Pope Julius
- 350? Julius Firmicus Maternus
- 350? Codex Sinaiticus(\(\xi\)), Codex Vaticanus Graecus 1209(B): earliest Christian Bibles, Alexandrian text-type
- 350? Ulfilas, Arian, apostle to the Goths, translates Greek NT to Gothic
- 350? Comma Johanneum 1Jn5:7b-8a(KJV)
- 350? Aëtius, Arian, "Syntagmation": "God is agennetos (unbegotten)", founder of Anomoeanism
• 350? School of Nisibis founded
• 353–367 Hilary, bishop of Poitiers
• 355–365 Antipope Felix II, Arian, supported by Constantius II, consecrated by Acacius of Caesarea
• 357 Third Council of Sirmium issues so-called Blasphemy of Sirmium or Seventh Arian Confession, called high point of Arianism
• 359 Council of Rimini, Dated Creed (Acacians); Pope Liberius rejects Arian creed of council
• 360 Julian the Apostate becomes the last non-Christian Roman Emperor
• 363–364 Council of Laodicea: Canon 29 decreed anathema for Christians who rest on the Sabbath, disputed Canon 60 named 26 NT books (excluded Revelation)
• 366–367 Antipope Ursicinus, rival to Pope Damasus I
• 367–403 Epiphanius, Bishop of Salamis, wrote Panarion against heresies
• 370–379 Basil the Great, Bishop of Caesarea
• 370? Doctrine of Addai at Edessa proclaims 17 book NT canon using Diatessaron (instead of the 4 Gospels) + Acts + 15 Pauline Epistles (inc. 3 Corinthians) Syriac Orthodox Church
• 370 (d. ca.) Optatus of Milevis, who in his conflict with the sectarian Donatists stressed unity and catholicity as marks of the Church over and above holiness, and also that the sacraments derived their validity from God, not from the priest
• 372–394 Gregory, Bishop Of Nyssa
• 373 Ephrem the Syrian, cited Western Acts
• 374–397 Ambrose, governor of Milan until 374, then made Bishop of Milan
• 375–395 Ausonius, Christian governor of Gaul
• 379–381 Gregory Nazianzus, Bishop of Constantinople
• 380, February 27: Emperor Theodosius I issues the Edict of Thessalonica, declaring Nicene Christianity as the state church of the Roman Empire
• 380, November 24: Emperor Theodosius I is baptised
• 381 First Council of Constantinople, 2nd ecumenical: Jesus had true human soul, Nicene Creed of 381
• 382 Catholic Council of Rome under Pope Damasus I sets the Biblical canon, listing the inspired books of the Old Testament and the New Testament (disputed)
• 383? Frumentius, Apostle of Ethiopia
• 385 Priscillian, first heretic to be executed?
• 386 Cyril of Jerusalem: wrote compellingly of catholicity of the Church
• 390? Apollinaris, Bishop of Laodicea, believed Jesus had human body but divine spirit
• 391: The Theodosian decrees outlaw most pagan rituals still practiced in Rome
• 396–430 Augustine, bishop of Hippo, considered the founder of formalized Christian theology (Nicene and Post-Nicene Fathers)
• 397? Saint Ninian evangelizes Picts in Scotland
• 398–404 John Chrysostom, Patriarch of Constantinople, see also List of Patriarchs of Constantinople, (Nicene and Post-Nicene Fathers)
• 400: Jerome's Vulgate (Latin edition and translation of the Bible) is published
• 400? Ethiopic Bible: in Ge'ez, 81 books, standard Ethiopian Orthodox Bible
• 400? Peshitta Bible in Syriac (Aramaic), Syr(p), OT + 22 NT, excludes: 2Pt, 2-3Jn, Jude, Rev; standard Syriac Orthodox Church Bible
• 406 Armenian Bible, translated by Saint Mesrop, standard Armenian Orthodox Bible
• 410, 24 August: Sack of Rome by Alaric and the Visigoths
• 412-444 Cyril, bishop of Alexandria, coined Hypostatic union
• 418-419 Antipope Eulalius, rival to Pope Boniface I
• 420 St. Jerome, Vulgate translator, Latin scholar, cited expanded ending in Mark after Mark 16:8, Pericope of the Adultress addition to John (John 7:53-8:11) (Nicene and Post-Nicene Fathers)
• 423–457 Theodoret, bishop of Cyr rhus, noted Tatian's Diatesseron in heavy use, wrote a Church History
• 431 Council of Ephesus, 3rd ecumenical: repudiated Nestorianism, decreed Mary the Mother of God, forbade any changes to Nicene Creed of 381, rejected by the Persian Church, leading to the Nestorian Schism
• 432 St Patrick begins his mission in Ireland. Almost the entire nation is Christian by the time of his death in a conversion that is both incredibly successful and largely bloodless
• 440–461 Pope Leo the Great: sometimes considered the first pope (of influence) by non-Catholics, stopped Attila the Hun at Rome, issued Tome in support of Hypostatic Union, approved Council of Chalcedon but rejected canons in 453
• 449 Second Council of Ephesus, Monophysite: Jesus was divine but not human
• 450? Codex Alexandrinus(A): Alexandrian text-type; Codex Bezae(D): Greek/Latin Gospels + Acts; Codex Washingtonianus(W): Greek Gospels; both of Western text-type
• 450? std. Aramaic Targums, Old Testament in Aramaic
• 450? Socrates Scholasticus Church History of 305-438; Sozomen Church History of 323-425
• 451 Council of Chalcedon, 4th ecumenical, declared Jesus is a Hypostatic Union: both human and divine in one (Chalcedonian Creed), rejected by Oriental Orthodoxy
- 455: Sack of Rome by the Vandals. The spoils of the Temple of Jerusalem previously taken by Titus are allegedly among the treasures taken to Carthage
- 456? Eutyches of Constantinople, Monophysite
- 465? Prosper of Aquitaine
- 476, September 4 Emperor Romulus Augustus is deposed in Rome, marked by many as the fall of the Western Roman Empire
- 484–519 Acacian schism, over Henoticon, divides Eastern (Greek) and Western (Latin) churches
- 491 Armenian Orthodox split from East (Greek) and West (Latin) churches
- 495, May 13 Vicar of Christ decreed a title of Bishop of Rome by Pope Gelasius I
- 496 Clovis I, King of the Franks, baptized
- 498–499, 501–506 Antipope Laurentius, rival of Pope Symmachus, Laurentian schism
- 500? Incense introduced in Christian church service, first plans of Vatican
- 524 Boethius, Roman Christian philosopher, wrote "Theological Tractates", Consolation of Philosophy; (Loeb Classics) (Latin)
- 525 Dionysius Exiguus defines Christian calendar (AD)
- 527 Fabius Planciades Fulgentius
- 529 Benedict of Nursia establishes his first monastery in the Abbey of Monte Cassino, Italy, where he writes the Rule of St Benedict
- 530 Antipope Dioscorus, possibly a legitimate Pope
- 535–536 Unusual climate changes recorded
- 537–555 Pope Vigilius, involved in death of Pope Silverius, conspired with Justinian and Theodora, on April 11, 548 issued Judicatum supporting Justinian's anti-Hypostatic Union, excommunicated by bishops of Carthage in 550
- 538 Byzantine general Belisarius defeats last Arian kingdom; Western Europe completely Catholic
- 541–542 Plague of Justinian
- 543 Justinian condemns Origen, disastrous earthquakes hit the world
- 544 Justinian condemns the Three Chapters of Theodore of Mopsuestia (died 428) and other writings of Hypostatic Union Christology of Council of Chalcedon
- 550 St. David converts Wales, crucifix introduced
- 553 Second Council of Constantinople, 5th ecumenical, called by Justinian
- 556–561 Pope Pelagius I, selected by Justinian, endorsed Judicatum
- 563 Columba goes to Scotland to evangelize Picts, establishes monastery at Iona
• 567 Cassiodorus
• 589 Catholic Third Council of Toledo: Reccared and the Visigoths convert from Arianism to Catholicism and Filioque clause is added to Nicene Creed of 381
• 590–604 Pope Gregory the Great, whom many consider the greatest pope ever, reforms church structure and administration and establishes Gregorian chant, Seven deadly sins
• 591–628 Theodelinda, Queen of the Lombards, began gradual conversion from Arianism to Catholicism
• 596 St. Augustine of Canterbury sent by Pope Gregory to evangelise the Jutes
• 600? Evagrius Scholasticus, Church History of AD431-594
• 604 Saxon cathedral created (by Mellitus) where St Paul's Cathedral in London now stands
• 609 Pantheon, Rome renamed Church of Santa Maria Rotonda
• 612? Bobbio monastery in northern Italy
• 613 Abbey of St. Gall in Switzerland
• 614 Khosrau II of Persia conquers Damascus, Jerusalem, takes Holy Cross of Christ
• 622 Mohammed founds Islam after fleeing to Mecca
• 624 Battle of Badr, considered beginning of Islamic Empire
• 625 Paulinus of York comes to convert Northumbria
• 628 Babai the Great, pillar of Church of the East, dies
• 628–629 Battle of Mut'ah: Heraclius recovers Cross of Christ and Jerusalem from Islam until 638
• 632 Eorpwald of East Anglia baptized under influence of Edwin of Northumbria
• 634–644 Umar, 2nd Sunni Islam Caliph: capital at Damascus, conquered Syria in 635, defeated Heraclius at Battle of Yarmuk in 636, conquered Egypt and Armenia in 639, Persia in 642
• 635 Cynegils of Wessex baptized by Bishop Birinus
• 664 Synod of Whitby unites Celtic Christianity of British Isles with Roman Catholicism
• 680–681 Third Council of Constantinople, 6th ecumenical, against Monothelites, condemned Pope Honorius I, Patriarch Sergius I of Constantinople, Heraclius' Ecthesis
• 681–686 Wilfrid converts Sussex
• 687–691 Dome of the Rock built
• 690? Old English Bible translations
• 692 Orthodox Quinisext Council, convoked by Justinian II, approved Canons of the Apostles of Apostolic Constitutions, Clerical celibacy, rejected by Pope Constantine
• 698 Fall of Carthage
- 711–718 Umayyad conquest of Hispania
- 717–718 Second Arab siege of Constantinople
- 718–1492 Reconquista: Iberian Peninsula retaken by Roman Catholic Visigoth monarchs
- 718 Saint Boniface, archbishop of Mainz; an Englishman, given commission by Pope Gregory II to evangelize the Germans
- 720? Disentis Abbey of Switzerland
- 730–787 First Iconoclasm: Byzantine Emperor Leo III bans Christian icons; Pope Gregory II excommunicates him
- 731 English Church History written by Bede
- 732 Battle of Tours stops Islam from expanding westward
- 750? Tower added to St Peter's Basilica at the front of the atrium
- 752? Donation of Constantine, granted Western Roman Empire to the Pope (later proved a forgery)
- 756 Donation of Pepin recognizes Papal States
- 781 Nestorian Stele, Daqin Pagoda, Jesus Sutras, Christianity in China
- 787 Second Council of Nicaea, 7th ecumenical: ends first Iconoclasm
- 793 Sacking of the monastery of Lindisfarne marks the beginning of Viking raids on Christendom

Middle Ages

- 800 King Charlemagne of the Franks is crowned first Holy Roman Emperor of the West by Pope Leo III
- 849-865 Ansgar, Archbishop of Bremen, "Apostle of the North", began evangelisation of North Germany, Denmark, Sweden
- 855 Antipope Anastasius: Louis II, Holy Roman Emperor appoints him over Pope Benedict III but popular pressure causes withdrawal
- 863 Saint Cyril and Saint Methodius sent by the Patriarch of Constantinople to evangelise the Slavic peoples. They translate the Bible into Slavonic
- 869-870 Catholic Fourth Council of Constantinople condemns Patriarch Photius (rejected by Orthodox)
- 879-880 Orthodox Fourth Council of Constantinople restores Photius, condemns Pope Nicholas I and Filioque (rejected by Catholics)
- 897, January Cadaver Synod: Pope Stephen VI conducts trial against dead Pope Formosus, public uprising against Stephen leads to his imprisonment and strangulation
- 909 Abbey of Cluny, Benedictine monastery, founded in France
- 966 Duke Mieszko I of Poland baptised; Poland becomes a Christian country
- 984 Antipope Boniface VII, murdered Pope John XIV, alleged to have murdered Pope Benedict VI in 974
- 988? Christianization of Kievan Rus’
- 991 Archbishop Arnulf of Rheims accuses Pope John XV of being the Antichrist
- 997-998 Antipope John XVI, deposed by Pope Gregory V and his cousin Holy Roman Emperor Otto III
- 1000 or 1001 Saint Stephen of Hungary crowned; Hungary becomes a Christian country
- 1001 Byzantine emperor Basil II and Fatimid Caliph Al-Hakim bi-Amr Allah execute a treaty guaranteeing the protection of Christian pilgrimage routes in the Middle East
- 1009 Caliph Al-Hakim bi-Amr Allah destroys the Church of the Holy Sepulchre, built over the tomb of Jesus in Jerusalem, and then rebuilds it to its current state
- 1012 Antipope Gregory VI, removed by Henry II, Holy Roman Emperor
- 1030 Battle of Stiklestad, considered victory of Christianity over Norwegian paganism
- 1045 Sigfrid of Sweden, Benedictine evangelist
- 1046 Council of Sutri: Pope Sylvester III exiled, Pope Gregory VI admits to buying the papacy and resigns, Pope Benedict IX resigns, council appoints Pope Clement II
- 1054 East–West Schism split between Eastern (Orthodox Christianity) and Western (Roman Catholic) churches formalized
- 1058–1059 Antipope Benedict X, defeated in war with Pope Nicholas II and Normans
- 1061–1064 Antipope Honorius II, rival of Pope Alexander II
- 1065 Westminster Abbey consecrated
- 1073–1085 Pope Gregory VII: Investiture Controversy with Henry IV, Holy Roman Emperor, proponent of clerical celibacy, opponent of simony, concubinage, Antipope Clement III
- 1079 Stanislaus of Szczepanów, patron saint of Poland
- 1080 Hospital of Saint John the Baptist founded in Jerusalem by merchants from Amalfi and Salerno – serves as the foundation for the Knights Hospitaller
- 1082 Engelberg Abbey of Switzerland built
- 1095–1291 10 Crusades, first called by Pope Urban II at Council of Clermont against Islamic Empire, to reconquer the Holy Land for Christendom
- 1098 Foundation of the reforming monastery of Cîteaux, leads to the growth of the Cistercian order
- 1101 Antipope Theodoric and Antipope Adalbert deposed by Pope Paschal II
- 1113 Knights Hospitaller confirmed by Papal bull of Pope Paschal II, listing Blessed Gerard (Gerard Thom) as founder, (a.k.a. Sovereign Order of Saint John of Jerusalem of Rhodes and of Malta, Knights of Malta, Knights of Rhodes, and Chevaliers of Malta)
- 1118 Knights Templar founded, to defend Holy Land
- 1123 Catholic First Lateran Council
- 1124 Conversion of Pomerania – first mission of Otto of Bamberg
- 1128 Holyrood Abbey in Scotland
- 1128 Conversion of Pomerania – second mission of Otto of Bamberg
- 1130 Peter of Bruys burned at the stake
- 1131 Tintern Abbey founded in Wales
- 1131–1138 Antipope Anacletus II
- 1139 Catholic Second Lateran Council
- 1140? Decretum Gratiani, Catholic Canon law
- 1142 Peter Abélard, Letters of Abelard and Heloise
- 1144 The Saint Denis Basilica of Abbot Suger is the first major building in the style of Gothic architecture
- 1154–1159 Pope Adrian IV, first (and to date only) English pope
- 1155 Theotokos of Vladimir arrives to Bogolyubovo
- 1155 Carmelites founded
- 1163 Construction begins on Notre Dame de Paris
- 1168 Conversion of Pomerania – Principality of Rugia missioned by Absalon
- 1173 Waldensians founded
- 1179 Catholic Third Lateran Council
- 1191 Teutonic Knights founded
- 1204–1261 Latin Empire of Constantinople
- 1205 Saint Francis of Assisi becomes a hermit, founding the Franciscan order of friars; renounces wealth and begins his ministry
- 1208 Start of the Albigensian Crusade against the Cathars
- 1214 Rosary is reportedly given to St. Dominic (who founded Dominican Order) by an apparition of Mary
- 1215 Catholic Fourth Lateran Council decrees special dress for Jews and Muslims, and declares Waldensians, founded by Peter Waldo, as heretics. One of the goals is the elimination of the heresy of the Cathars
• 1219 Francis of Assisi crosses enemy lines during the Fifth Crusade to speak to Sultan al-Kamil; the meeting ends with a meal. James of Vitry writes that Muslim soldiers returned Francis and another friar, Illuminato, "with signs of honor."

• 1220–1263 St Alexander Nevsky, holy patron of Russia

• 1231 Charter of the University of Paris granted by Pope Gregory IX

• 1241 Pope Gregory IX denounced as Antichrist by Eberhard II von Truchsees, Prince-Archbishop of Salzburg, at the Council of Regensburg

• 1245 Catholic First Council of Lyon

• 1252, May 15 Ad extirpanda: Pope Innocent IV authorizes use of torture in Inquisitions

• 1260 Date at which a 1988 Vatican sponsored scientific study places the origin of the Shroud of Turin

• 1263, July 20–24 The Disputation of Barcelona is held at the royal palace of King James I of Aragon in the presence of the King, his court, and many prominent ecclesiastical dignitaries and knights, between a convert from Judaism to Christianity Dominican Friar Pablo Christiani and Rabbi Nachmanides

• 1274 Summa Theologiae, written by Thomas Aquinas, theologian and philosopher, landmark systematic theology which later becomes official Catholic doctrine

• 1274 Catholic Second Council of Lyon

• 1291 Last Crusader city (Acre) falls to the Mamelukes

Renaissance

• 1308–1321 Divine Comedy (Divina Commedia), by Dante Alighieri; most consensual dates are: Inferno written between 1307–1308, Purgatorio from 1307–1308 to 1313–1314 and last Paradiso from 1313–1314 to 1321 (year of Dante's death)

• 1307 The arrest of many of the Knights Templar, beginning confiscation of their property and extraction of confessions under torture

• 1305–1378 Avignon Papacy, Popes reside in Avignon, France

• 1311–1312 Catholic Council of Vienne disbands Knights Templar

• 1313 Foundation of the legendary Order of the Rose Cross (Rosicrucian Order), a mystic Christian fraternity for the first time expounded in the Divine Comedy

• 1314 Jacques de Molay, last Grandmaster of the Knights Templar, burned at the stake

• 1326 Metropolitan Peter moves his see from Kiev to Moscow
• 1341–1351 Orthodox Fifth Council of Constantinople
• 1342 Marsilius of Padua
• 1345 Sergii Radonezhskii founds a hermitage in the woods, which grows into the Troitse-Sergiyeva Lavra
• 1378–1418 Western Schism in Roman Catholicism
• 1380–1382 Wycliffe's Bible, by John Wycliffe, eminent theologian at Oxford, NT in 1380, OT (with help of Nicholas of Hereford) in 1382, translations into Middle English, 1st complete translation to English, includes deuterocanonical books, preaches against abuses, expresses anti-catholic views of the sacraments (Penance and Eucharist), the use of relics, and clerical celibacy
• 1388 Twenty-five Articles of the Lollards published
• 1408 Council of Oxford forbids translations of the Scriptures into the vernacular, unless and until they are fully approved by church authority
• 1409 Council of Pisa declares Roman Pope Gregory XII and Avignon Pope Benedict XIII deposed, elected Pope Alexander V (called the Pisan Pope)
• 1414–1418 Catholic Council of Constance asks Gregory XII, Benedict XIII, Pisan Pope John XXIII to resign their papal claims, then elects Pope Martin V; condemns John Wycliffe and Jan Hus, who is burned at the stake
• 1423–1424 Council of Siena
• 1425 Catholic University of Leuven
• 1430? Andrei Rublev, the greatest of medieval icon-painters
• 1431 St. Joan of Arc, French national heroine, burned at the stake
• 1431–1445 Catholic Council of Basel-Ferrara-Florence
• 1439 Notre-Dame de Strasbourg, highest building in the world until 1874
• 1452 Dum Diversas, papal bull issued on 18 June 1452, credited with ushering in the West African slave trade in Europe and the New World
• 1453 Fall of Constantinople, overrun by Ottoman Empire
• 1455 Gutenberg Bible, first printed Bible, by Johann Gutenberg
• 1473–1481 Sistine Chapel built
• 1478 Spanish Inquisition established by Pope Sixtus IV
• 1483 Martin Luther born in Eisleben
• 1484 December 5, Summis desiderantes against Witchcraft issued by Pope Innocent VIII
• 1487 Persecution and crusade against the Waldensians instigated by Pope Innocent VIII
• 1492 Columbus opens new continents to Christianity
• 1498 Girolamo Savonarola, Dominican priest, writes Bonfire of the Vanities
• 1506 Pope Julius II orders the Old St. Peter's Basilica torn down and authorizes Donato Bramante to plan a new structure (demolition completed in 1606); Vatican Swiss Guard founded
• 1508–1512 Michelangelo frescoes the Sistine Chapel's vaulted ceiling
• 1510s A number of theologians in the Holy Roman Empire start to preach reformational ideas shortly before Martin Luther, including Christoph Schappeler in Memmingen (1513), but fail to spark a larger movement
• 1512–1517 Catholic Fifth Council of the Lateran: condemned Conciliarism

Reformation

• 1517 95 Theses of Martin Luther begins the Reformation and Lutheranism
• 1518 Heidelberg Disputation: Martin Luther puts forth his Theology of the Cross
• 1519 Leipzig Debate between Martin Luther and Johann Eck
• 1519 Huldrych Zwingli begins the Reformed tradition, sparking the Reformation in Switzerland
• 1520 Luther publishes three monumental works, To the Christian Nobility of the German Nation, On the Babylonian Captivity of the Church, and On the Freedom of a Christian
• 1521 Luther refuses to recant his works at the Diet of Worms
• 1521 Papal bull Decet Romanum Pontificem (It Pleases the Roman Pontiff) excommunicates Luther
• 1521 Ferdinand Magellan claims the Philippines for Spain, first mass and subsequent conversion to Catholicism, first in East Asia
• 1522 Luther Bible, German NT translation
• 1524 The Freedom of the Will published by Erasmus
• 1525 On the Bondage of the Will published by Luther in response to Erasmus
• 1525 Anabaptist movement begins
• 1526 Tyndale's NT, English NT translation from 1516 Greek text of Erasmus, first printed edition, reflects influence of Luther's NT in rejecting priest for elder, church for congregation, banned in 1546 by Henry VIII of England
• 1526 Luther publishes his German Mass and The Sacrament of the Body and Blood of Christ—Against the Fanatics, his first written work against the Sacramentarians
• 1528 Reformation in Denmark-Norway and Holstein, Lutheranism is officially adopted
• 1528 Luther affirms the real presence of Christ's body and blood in his Confession Concerning Christ's Supper
- 1529 Marburg Colloquy, Luther defends doctrine of Real Presence in discussion with Zwingli
- 1530 Augsburg Confession, first doctrinal statement of the Lutheran Church
- 1531 Huldrych Zwingli is killed during the Second war of Kappel
- 1531 Our Lady of Guadalupe in Mexico: According to tradition, when the roses fell from it the icon of the Virgin of Guadalupe appeared imprinted on the cactus cloth. The sudden, extraordinary success of the evangelizing of ten million Indians in the decade of 1531–1541.
- 1534 Henry VIII establishes new independent entity Church of England, see also English Reformation
- 1535–1537 Myles Coverdale's Bible, used Tyndale's NT along with Latin and German versions, included Apocrypha at the end of the OT (like Luther's Bible of 1534) as was done in later English versions, 1537 edition received royal licence, but banned in 1546 by Henry VIII
- 1535 Thomas More refuses to accept King Henry VIII's claim to be the supreme head of the Church in England, and is executed
- 1535–1679 Forty Martyrs of England and Wales
- 1536 Desiderius Erasmus, eminent Dutch humanist and editor of the Textus Receptus, dies
- 1536 Tyndale put to death, left his OT translation in manuscript, English ecclesiastical authorities ordered his Bible burned because it was thought to be part of Lutheran reform
- 1536 Institutes of the Christian Religion written by John Calvin (Calvinism)
- 1536 John of Leiden, fanatic Dutch Anabaptist
- 1536 Jacob Hutter, founder of Hutterites
- 1536 Helvetic Confessions of the Reformed Churches of Switzerland
- 1536–1540 Dissolution of the Monasteries in England, Wales and Ireland
- 1536 Pilgrimage of Grace
- 1536–1541 Michelangelo paints "The Last Judgement"
- 1537 Christian III of Denmark decreed Lutheranism state religion of Norway and Denmark
- 1537 Luther writes Smalcald Articles
- 1537–1551 Matthew Bible, by John Rogers, based on Tyndale and Coverdale received royal licence but not authorized for use in public worship, numerous editions, 1551 edition contained offensive notes (based on Tyndale)
- 1539–1569 Great Bible, by Thomas Cromwell, 1st English Bible to be authorized for public use in English churches, defective in many places, based on last Tyndale's NT of 1534–1535, corrected by a Latin version of the Hebrew OT, Latin Bible of Erasmus, and Complutensian Polyglot, last edition 1569, never denounced by England
• 1540 Jesuit order founded by Ignatius of Loyola, helped reconvert large areas of Poland, Hungary, and south Germany and sent missionaries to the New World, India, and China

• 1541 John Calvin returns to Geneva

• 1542 Roman Inquisition established by Pope Paul III

• 1542 Robert Bellarmine born – became a Cardinal Inquisitor under Pope Clement VIII

• 1543 Parliament of England bans Tyndale's translation as a "crafty, false and untrue translation"

• 1545–1563 Catholic Council of Trent: Counter-Reformation against Protestantism, clearly defined an official theology and biblical canon

• 1549 Original Book of Common Prayer of the Church of England written by Thomas Cranmer

• 1551 The Stoglav Church Council (One Hundred Chapters) Moscow, Russia

• 1552 Joachim Westphal starts controversy against Calvinists, defending Lutheran doctrine of Real Presence

• 1552 Francis Xavier, Jesuit missionary, "Apostle of the Indies"

• 1553 Pontifical Gregorian University founded at Vatican City

• 1553 Michael Servetus founder of Unitarianism, burned at the stake in Geneva

• 1553–1558 Queen Mary I of England persecutes reformers: John Rogers, Hugh Latimer, Nicholas Ridley, Thomas Cranmer; of 238 burned at the stake

• 1555 Peace of Augsburg gives religious freedom in Germany only to Lutheran Protestants

• 1558 Church of England permanently reestablished after Mary I of England dies

• 1559 Military Order of the Golden Spur founded by Pope Paul IV

• 1560 Geneva Bible, NT a revision of Matthew's version of Tyndale with use of Theodore Beza's NT (1556), OT a thorough revision of Great Bible, appointed to be read in Scotland (but not England), at least 140 editions, first Bible with chapter and verse numbers

• 1560 Scots Confession, Church of Scotland, Scottish Reformation

• 1560–1598 French Wars of Religion

• 1560–1812 Goa Inquisition, persecution of Hindus and Jews in India, see also Christianity in India

• 1561 Menno Simons, founder of Mennonites

• 1563 Thirty-Nine Articles of Church of England, also decreed Biblical canon

• 1563 Heidelberg Catechism of Reformed churches

• 1565–73 Examination of the Council of Trent by Martin Chemnitz

• 1566 Roman Catechism and Index of Prohibited Books published

• 1569 Metropolitan Philip of Moscow strangled by Malyuta Skuratov
• 1570 Pope Pius V issued a bull *Quo primum*; He standardised the Holy Mass by promulgating the 1570 edition of the Roman Missal.

• 1571 Dutch Reformed Church established

• 1571 Battle of Lepanto saves Christian Europe; Pope Pius V organizes the Holy League led by Don Juan de Austria to defend Europe from the larger Islamic Ottoman forces (230 galleys and 56 galliots)

• 1572 John Knox founds Scottish Presbyterian Church, due to disagreement with Lutherans over sacraments and church government

• 1572–1606 Bishops' Bible, a revision of the Great Bible checked against the Hebrew text, 1st to be published in England by episcopal authority

• 1572 St. Bartholomew's Day Massacre: Thousands of Protestants murdered in France

• 1577 Formula of Concord adopted by German Lutherans

• 1579 Discovery of the holiest Russian icon, *Our Lady of Kazan*

• 1580 Book of Concord of Lutheranism

• 1582 St Teresa of Avila dies

• 1582 Gregorian calendar of Pope Gregory XIII adopted at different times in different regions of the world

• 1582 Rheims New Testament published – it later became part of the 1610 Douay–Rheims Bible

• 1585 Jesuit scholar Francisco Ribera publishes first futurist interpretation, of the Biblical books of Daniel and Revelation

• 1587 Toyotomi Hideyoshi expels Jesuits from Kyūshū

• 1587? Mission Nombre De Dios in St. Augustine, Florida, considered first Catholic mission to North America

• 1588 Spanish Armada defeated in its efforts to reconquer England for Catholicism

• 1589 Metropolitan Jove is elected the first Patriarch of Moscow

• 1590 Michelangelo's dome in St Peter's Basilica completed

• 1591 St John of the Cross

• 1592 The Clementine Vulgate of Pope Clement VIII, replaced the Sistine Vulgate of 1590, the standard Latin Catholic Bible until the Second Vatican Council

• 1596 Ukrainian Catholic Church forms when Ukrainian subjects of the king of Poland are reunited with Rome, largest Byzantine Catholic Church

• 1598 Edict of Nantes grants toleration to French Protestants (Huguenots)

• 1600 Giordano Bruno, Dominican priest, burned at the stake
17th century

- 1604 Fausto Paolo Sozzini Socinianism
- 1606 Carlo Maderno redesigns St Peter’s Basilica into a Latin cross
- 1607 Jamestown, Virginia founded
- 1608 Quebec City founded by Samuel de Champlain
- 1609 Baptist Church founded by John Smyth, due to objections to infant baptism and demands for church-state separation
- 1609–1610 Douay-Rheims Bible, 1st Catholic English translation, OT published in two volumes, based on an unofficial Louvain text corrected by Sistine Vulgate, NT is Rheims text of 1582
- 1611 King James Version (Authorised Version) is published, based primarily on Tyndale’s work and Bishop’s Bible of 1572, first printings included separate Apocrypha between the testaments
- 1614 Fama Fraternitatis, the first Rosicrucian manifesto (may have been in circulation ca. 1610) presenting “The Fraternity of the Rose Cross”
- 1615 Confessio Fraternitatis, the second Rosicrucian manifesto describing the “Most Honorable Order” as Christian
- 1616 Chemical Wedding of Christian Rosenkreutz, the third Rosicrucian manifesto (an hermetic allegory presenting alchemical and Christian elements)
- 1618–1648 Thirty Years’ War
- 1620 Plymouth Colony founded by Puritans
- 1622–1642 Armand Jean du Plessis, Cardinal Richelieu
- 1630 City upon a Hill, sermon by John Winthrop
- 1634-37 Confessio catholica by Lutheran theologian Johann Gerhard
- 1635 Roger Williams banished from Massachusetts Bay Colony, for advocating separation of church and state
- 1636 Founding of what was later known as Harvard University as a training school for ministers – the first of thousands of institutions of Christian higher education founded in the USA
- 1636–1638 Cornelius Jansen, bishop of Ypres, founder of Jansenism
- 1637–1638 Shimabara Rebellion
- 1638 Anne Hutchinson banished as a heretic from Massachusetts
- 1641 John Cotton, advocate of theonomy, helps to establish the social constitution of the Massachusetts Bay Colony
1642, 15 September-27 October: Synod of Jassy at Iaşi (Jassy)
1643 Acta Sanctorum
1643 John Campanius arrives in New Sweden
1644 Rhode Island founded by Roger Williams as first colony to establish complete religious liberty
1644 Long Parliament directs that only Hebrew canon be read in the Church of England (effectively removing the Apocrypha)
1646 Westminster Standards produced by the Assembly, one of the first and undoubtedly the most important and lasting religious document drafted after the reconvention of the Parliament, also decrees Biblical canon
1648 George Fox founds the Quaker movement
1648 Treaty of Westphalia ends Thirty Years’ War, extends religious toleration to Calvinists
1650 Bishop James Ussher calculates date of creation as October 23, 4004 BC
1653–56 Raskol of the Russian Orthodox Church
1655–1677, Abraham Calovius publishes *Systema locorum theologicorum*, height of Lutheran scholasticism
1660–1685 King Charles II of England, restoration of monarchy, continuing through James II, reversed decision of Long Parliament of 1644, reinstating the Apocrypha, reversal not heeded by non-conformists
1666 Paul Gerhardt, Lutheran pastor and hymnwriter, is removed from his position as a pastor in Nikolaikirche in Berlin, when he refuses to accept "syncretistic" edict of the Elector Friedrich Wilhelm I of Brandenburg
1672 Greek Orthodox Synod of Jerusalem: decreed Biblical canon
1675 Philipp Jakob Spener publishes *Pia Desideria*, which becomes a manifesto for Pietism
1678 John Bunyan publishes *Pilgrim's Progress*
1682 Avvakum, leader of the Old Believers, burned at the stake in the Far North of Russia
1683 Roger Williams, advocate of Separation of church and state, founder of Providence, Rhode Island, dies
1685 Edict of Fontainebleau outlaws Protestantism in France
1685 James II of England baptizes his son as a Catholic
1685 Orthodoxy introduced to Beijing by Russian Orthodox Church
1688 'Glorious Revolution' overthrows James II of England over fears of Catholic restoration; William of Orange takes English throne
1689 English Bill of Rights establishes religious liberty
• 1692 Salem witch trials held in Colonial America
• 1692–1721 Chinese Rites controversy
• 1693 Jacob Amman founds Amish sect

18th century

• 1701 Old Catholic Church of the Netherlands splits with Roman Catholicism
• 1706 Bartholomäus Ziegenbalg, missionary, arrives in Tranquebar
• 1707 Examen theologicum acroamaticum by David Hollatz: the last great Lutheran doctrinal work before the Age of Enlightenment
• 1718-22 Orthodox Lutheran Valentin Ernst Löscher publishes The Complete Timotheus Verinus against Pietism
• 1721 Peter the Great substitutes Moscow Patriarchate with the Holy Synod
• 1722 Hans Egede, missionary, arrives in Greenland
• 1728 The Vicar of Bray (song)
• 1730–1749 First Great Awakening in U.S.
• 1735 Welsh Methodist revival
• 1738 Methodist movement, led by John Wesley and his hymn-writing brother Charles, begins
• 1740 Johann Phillip Fabricius, missionary, arrives in South India
• 1741 Sinners in the Hands of an Angry God, famous Fire and brimstone sermon
• 1741 George Frederick Handel performs his classic gospel oratorio "Messiah" for the first time
• 1754 An Historical Account of Two Notable Corruptions of Scripture, by Isaac Newton, published
• 1767–1815 Suppression of the Jesuits
• 1768 New Smyrna, Florida, Greek Orthodox colony, founded
• 1768 Reimarus dies without publishing his radical critic work distinguishing Historical Jesus versus Christ of Faith
• 1769 Mission San Diego de Alcalá, first California mission
• 1771 Emanuel Swedenborg publishes his "Universal Theology of the True Christian Religion", later used by others to found Swedenborgianism
• 1774 Ann Lee, leader of American Shakers, emigrates to New York from England
• 1774 Gotthold Ephraim Lessing starts publishing Reimarus' works on historical Jesus as Anonymous Fragments, starting Liberal Theology Era (in Christology)
- 1776–1788 Gibbon's The History of the Decline and Fall of the Roman Empire, critical of Christianity
- 1776 Mission Dolores, San Francisco
- 1779 Virginia Statute for Religious Freedom: "Jesus never coerced anyone to follow him, and the imposition of a religion by government officials is impious"
- 1780 Robert Raikes begins Sunday schools to reach poor and uneducated children in England
- 1784 American Methodists form Methodist Episcopal Church at so-called "Christmas Conference", led by bishops Thomas Coke and Francis Asbury
- 1784 Roman Catholicism is introduced in Korea
- 1789–1815 John Carroll, Archdiocese of Baltimore, first Roman Catholic US bishop
- 1789–1801 Dechristianisation of France during the French Revolution
- 1791 First Amendment to the United States Constitution: "Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof"
- 1793 Herman of Alaska brings Orthodoxy to Alaska
- 1795 The Age of Reason, written by Thomas Paine, advocates Deism
- 1796 Treaty with Tripoli (1796), article 11: "the Government of the United States of America is not, in any sense, founded on the Christian religion"
- 1800 Friedrich Schleiermacher publishes his first book, beginning Liberal Christianity movement

19th century

- 1801 Cane Ridge Revival in Cane Ridge, Kentucky initiates the Christians (Stone Movement) wing of the Restoration Movement
- 1809 Disciples of Christ (Campbell Movement) wing of the Restoration Movement initiated with the publication of the *Declaration and Address of the Christian Association of Washington*
- 1815 Peter the Aleut, orthodox Christian, tortured and martyred in Catholic San Francisco, California
- 1816 Bishop Richard Allen, a former slave, founds the African Methodist Episcopal Church, the first African-American denomination
- 1817 Claus Harms publishes 95 theses against rationalism and the Prussian Union of churches
- 1819 Thomas Jefferson produces the Jefferson Bible
- 1820, Spring, Joseph Smith, Jr., founder of the Church of Jesus Christ of Latter-Day Saints, has first vision
- 1824 English translation of Wilhelm Gesenius' *Handwörterbuch...: Hebrew-English Lexicon*, Hendrickson Publishers
• 1827 Ernst Wilhelm Hengstenberg takes on the editorship of the *Evangelische Kirchenzeitung*, the chief literary organ of the Neo-Lutheranism
• 1828 Plymouth Brethren founded; promotes Dispensationalism
• 1830 Catherine Labouré receives Miraculous Medal from the Blessed Mother in Paris, France
• 1830 Charles Finney's revivals lead to Second Great Awakening in America
• 1830, April 6 the Church of Jesus Christ of Latter Day Saints (Mormonism, Latter Day Saint Movement) founded by Joseph Smith. Book of Mormon also published
• 1831 William Miller begins the Advent Movement, by preaching his first sermon on the Biblical books of Daniel and Revelation
• 1832 Christians (Stone Movement) and Disciples of Christ (Campbell Movement) merge to form the Stone-Campbell Restoration Movement
• 1832, February 28- Persecution of Old Lutherans: by a royal decree all Lutheran worship is declared illegal in Prussia in favour of the Prussian Union agenda
• 1833 John Keble's sermon "National Apostasy" initiates the Oxford Movement in England
• 1838–1839 Saxon Lutherans objecting to theological rationalism emigrate from Germany to the United States; settle in Perry County, Missouri. Leads to formation of the Lutheran Church–Missouri Synod
• 1843 Disruption of: schism within the established Church of Scotland
• 1844 Hans Paludan Smith Schreuder, missionary, arrives in Port Natal, South Africa
• 1844 Lars Levi Laestadius experiences awakening—beginning of Laestadianism
• 1844, June 27, Joseph Smith, Jr., founder of the Church of Jesus Christ of Latter-Day Saints, murdered at Carthage, Illinois
• 1844, October 22 Great Disappointment: false prediction of Second Coming of Christ by Millerites
• 1844, December Ellen G. White, co-founder and prophetess of the Seventh-day Adventist Church, has her first vision
• 1845 Southern Baptist Convention formed in Augusta, Georgia
• 1846 Our Lady of La Salette
• 1847 Lutheran Church–Missouri Synod founded in Chicago, Illinois
• 1847 John Christian Frederick Heyer, missionary, arrives in Andhra Pradesh, India
• 1848 Epistle to the Easterners and Encyclical of the Eastern Patriarchs response
• 1848 Oneida Community founded by John Humphrey Noyes in western New York state
• 1849 Johann Konrad Wilhelm Löhe founds the first deaconess house in Neuendettelsau, Bavaria
• 1850 Wisconsin Evangelical Lutheran Synod founded in Milwaukee
• 1853 Synod of the Norwegian Evangelical Lutheran Church in America founded outside Madison, Wisconsin
• 1854 Missionary Hudson Taylor arrives in China
• 1854 Immaculate Conception defined as Catholic dogma
• 1855 Søren Kierkegaard, founder of Christian existentialism
• 1855 Samuel Simon Schmucker begins attempt to replace the Augsburg Confession with the Definite Platform in the General Synod, leading to schism in 1866
• 1858 Bernadette Soubirous receives the first of 18 apparitions of Our Lady of Lourdes in Lourdes, France.
• 1859 Ashbel Green Simonton, missionary, arrives in Brazil and founds Igreja Presbiteriana do Brasil, the oldest Brazilian Protestant denomination
• 1863 Seventh-day Adventist Church officially formed 19 years after the Great Disappointment
• 1865 Methodist preacher William Booth founds the Salvation Army, vowing to bring the gospel into the streets to the most desperate and needy
• 1866 General Council (Lutheran) formed by ten Lutheran synods in the United States
• 1869–1870 Catholic First Vatican Council asserts doctrine of Papal Infallibility (rejected by Christian Catholic Church of Switzerland)
• 1870 Italy declares war on the Papal States; Italian Army enters Rome; Papal States cease to exist
• 1871 Pontmain, France is saved from advancing German troops with the appearing of Our Lady of Hope
• 1871–1878 German Kulturkampf against Roman Catholicism
• 1872 Evangelical Lutheran Synodical Conference of North America organized
• 1876 Evangelical Lutheran Free Church (Germany) founded
• 1878 First translation of the New Testament into Batak by Ludwig Ingwer Nommensen
• 1879 Knock, Ireland is location of apparition of Our Lady, Queen of Ireland
• 1879 Church of Christ, Scientist founded in Boston by Mary Baker Eddy
• 1881–1894 Revised Version, called for by Church of England, uses Greek based on Septuagint (B) and (S), Hebrew Masoretic Text used in OT, follows Greek order of words, greater accuracy than AV, includes Apocrypha, scholarship never disputed
• 1884 Charles Taze Russell founds Bible Student movement
• 1885–1887 Uganda Martyrs
• 1885 Baltimore Catechism published
• 1886 Moody Bible Institute founded
• 1886 Onesimos Nesib begins translation of the entire Bible into the Oromo language
1886 Johann Flierl, missionary, arrives in New Guinea
1891 Albert Maclaren and Copland King, Anglican missionaries, arrive in New Guinea
1893 Heresy trial of Luther Alexander Gotwald
1894 The Kingdom of God is Within You, by Leo Tolstoy, start of Christian anarchism
1897 Christian flag conceived in Brooklyn, New York
1899 Gideons International founded
1900 Eastern Orthodoxy is introduced in Korea

20th century

1903 First group baptism at Sattelberg Mission Station under Christian Keyser in New Guinea paves way for mass conversions during the following years
1904 Welsh revival
1904 Evangelical Lutheran Church of Brazil – Igreja Evangélica Luterana do Brasil – is founded in June 24, in São Pedro do Sul city, State Rio Grande do Sul
1905 French law on the separation of Church and State
1906 Albert Schweitzer publishes The Quest of the Historical Jesus (English translation 1910)
1906 Biblia Hebraica
1906–1909 Azusa Street Revival in Los Angeles, California begins modern Pentecostal movement
1907 The Church of God in Christ is formed as a Pentecostal body
1907–1912 Nicholas of Japan, Archbishop of Japanese Orthodox Church
1908 Church of the Nazarene founded in Pilot Point, Texas
1909 Scofield Reference Bible published
1909–1911 The Rosicrucian Fellowship, an international association of Esoteric Christian mystics, founded at Mount Ecclesia
1910 Christian Congregation in Brazil founded in Santo Antônio da Platina, Brazil by Italo-American Louis Francescon. It begins Pentecostalism in Brazil and South America
1910 Edinburgh Missionary Conference launches modern missions movement and modern ecumenical movement; 5-point statement of the Presbyterian General Assembly also used by Fundamentalists
1910–1915 The Fundamentals, a 12-volume collection of essays by 64 British and American scholars and preachers, forms foundation of Fundamentalism
1913 Catholic Encyclopedia
• 1914 Welsh Church Act 1914
• 1914 Iglesia ni Cristo incorporated in the Philippines by its founder Felix Y. Manalo
• 1914 Paul Olaf Bodding completes his translation of the Bible into the Santali language
• 1915 Ellen G. White, co-founder and prophetess of the Seventh-day Adventist Church, dies
• 1915–1923 The Armenian Genocide occurs
• 1916 Father Divine founds International Peace Mission movement
• 1916 And did those feet in ancient time
• 1917 Heinrich Hansen publishes Lutheran Evangelical Catholic theses _Stimuli et Clavi_
• 1917 _Our Lady of Fatima_ appears Marian apparitions to 3 young people, in Fátima, Portugal – Jacinta Marto, Francisco Marto and Lúcia Santos ("Sister Lucia")
• 1917 – 13 October Miracle of the Sun is witnessed by as many as 100,000 people in the Cova da Iria fields near Fátima, Portugal ("How the Sun Danced at Midday at Fátima")
• 1917 Restitution of the Moscow Patriarchy with Tikhon as patriarch
• 1917 True Jesus Church founded in Beijing
• 1918 Execution of Holy Martyrs of Russia, including the last tsar, Nicholas II, and his wife, Alexandra Feodorovna, by the Communists
• 1918 United Lutheran Church in America founded
• 1919 Karl Barth’s _Commentary on Romans_ is published, critiquing Liberal Christianity and beginning the neo-orthodox movement
• 1920 The Ecclesia, an Esoteric Christian Temple, is erected and dedicated on Christmas Day (December 25)
• 1921 Oxford Group founded at Oxford
• 1922 Greek Orthodox Archdiocese of America founded
• 1922 _The Holy Bible Containing the Old and New Testaments, a New Translation_ by James Moffatt published
• 1923 Aimee Semple McPherson builds Angelus Temple
• 1924 First religious radio station in the U.S., KFUO (AM), founded
• 1925 Scopes Trial causes division among Fundamentalists
• 1925 United Church of Canada formed
• 1925 St. Therese of Lisieux canonized
• 1925 The _World Conference of Life and Work_ is held in Stockholm, Sweden
• 1926 Father Charles Coughlin's first radio broadcast
• 1926–1929 Cristero War in Mexico: The Constitution of 1917 brings persecution of Christian practices and anti-clerical laws – approximately 4,000 Catholic priests are expelled, assassinated or executed
• 1927 Varghese Payyappilly Palakkappilly founds the Congregation of Sisters of the Destitute
• 1927 Pope Pius XI decrees Comma Johanneum open to dispute
• 1929 Lateran Treaty signed, containing three agreements between kingdom of Italy and the papacy
• 1929 Varghese Payyappilly Palakkappilly dies
• 1929 Voice of Prophecy radio ministry founded by Seventh-day Adventist pastor H.M.S. Richards Sr.
• 1930 Rastafari movement founded
• 1930 Old American Lutheran Church founded
• 1930 The Lutheran Hour begins with Walter A. Maier as speaker
• 1931 Jehovah's Witnesses formally separate from the Bible Student movement
• 1931 Christ the Redeemer (statue) built in Rio de Janeiro, Brazil
• 1932 Franz Pieper's A Brief Statement of the Doctrinal Position of the Missouri Synod adopted by the LCMS
• 1932 Marian apparitions to five school children in Beauraing, Belgium as Lady Virgin of the Poor
• 1933 Catholic Worker Movement founded
• 1933 The Holy Bible from Ancient Eastern Manuscripts by George Lamsa published
• 1934 Herbert W. Armstrong founds Radio Church of God
• 1935 Gunnar Rosendal publishes Lutheran High Church manifesto Kyrklig förnyelse
• 1935 Dr. Frank C. Laubach, known as "The Apostle to the Illiterates", working in the Philippines, develops a literacy program that continues to teach millions of people to read
• 1935 Rahlfs' critical edition of the Koine Greek Septuagint published
• 1935 Billy Sunday, early U.S. radio evangelist, dies
• 1938 First Debbarma Christian, Manindra Debbarma, is baptized at Agartala
• 1938 Tripura Baptist Christian Union established at Laxmilunga, Tripura
• 1939 Southern and Northern US branches of the Methodist Episcopal Church, along with the Methodist Protestant Church, reunite to form The Methodist Church (slavery had divided the church in the 19th century)
• 1940 Monumento Nacional de Santa Cruz del Valle de los Caidos, world's largest cross, 152.4 meters high
• 1942 National Association of Evangelicals founded
1945 On the Feast of the Annunciation, "Our Lady" appears to a simple woman, Ida Peerdeman, in Amsterdam. This is the first of 56 appearances as "Our Lady of All Nations", which took place between 1945 and 1959.

1945 Dietrich Bonhoeffer is executed by the Nazis

1945 Ludwig Müller

1945 The Nag Hammadi library is discovered

1945–1952 Revised Standard Version, revision of AV "based on consonantal Hebrew text" for OT and best available texts for NT, done in response to changes in English usage

1947 Uneasy Conscience of Modern Fundamentalism by Carl F. H. Henry, a landmark of Evangelicalism versus Fundamentalism in US

1947 Oral Roberts founds Evangelistic Association

1947 Dead Sea scrolls discovered

1947 Lutheran World Federation founded

1948 World Council of Churches is founded

1948 Declaration of the Establishment of the State of Israel, see also Christian Zionism

1949 evangelist Billy Graham preaches his first Los Angeles crusade


1950 First part of the Common Confession between the American Lutheran Church and the LCMS is adopted, resulting in the schism of the Orthodox Lutheran Conference

1950 New World Translation of the Christian Greek Scriptures released

1950 Assumption of Mary decreed by Pope Pius XII

1950 Missionaries of Charity founded by Mother Teresa

1951 Bishop Fulton Sheen (1919–1979) debuts his television program Life is Worth Living on the DuMont Network. His half hour lecture program on Roman Catholic theology remained the number one show on U.S. television for its time slot, winning several Emmys until Sheen ended the program in 1957

1951 The Last Temptation, a fictional account of the life of Jesus written by Nikos Kazantzakis, wherein Christ's divinity is juxtaposed with his humanity, is published, and promptly banned in many countries

1951 Campus Crusade for Christ founded at UCLA

1952 Novum Testamentum Graece, critical edition of Greek NT, basis of modern translations

1952 C. S. Lewis' Mere Christianity published

1952 This Is the Life TV series begins
• 1954 Unification Church founded by Reverend Sun Myung Moon, under the name Holy Spirit Association for the Unification of World Christianity (acronym HSA-UWC)
• 1954 U.S. Pledge of Allegiance modified by act of Congress from "one nation, indivisible" to "one nation under God, indivisible"
• 1956 In God We Trust designated U.S. national motto
• 1956 Anchor Bible Series
• 1956 The Ten Commandments (1956 film)
• 1956 It Is Written television ministry founded by Seventh-day Adventist pastor George Vandeman
• 1956 The Ten Commandments (1956 film)
• 1957 United Church of Christ founded by ecumenical union of Congregationalists and Evangelical & Reformed, representing Calvinists and Lutherans
• 1958 Sedevacantism
• 1959 Family Radio founded by Harold Camping
• 1959 Franz Pieper's A Brief Statement of the Doctrinal Position of the Missouri Synod reaffirmed by the LCMS
• 1960 Merger creates the "new" American Lutheran Church
• 1960 John F. Kennedy becomes the first Roman Catholic to be elected President of the United States
• 1961 New World Translation of the Holy Scriptures published
• 1961 Christian Broadcasting Network founded by Pat Robertson
• 1962 Engel v. Vitale, first U.S. Supreme Court decision against School prayer
• 1962 Karl Rahner, Joseph Ratzinger, Yves Congar, John Courtney Murray, Hans Küng among others appointed "periti" for upcoming Second Vatican Council. Rahner famous for paraphrasing Augustine's axiom: "Many whom God has the Church does not have; and many whom the Church has, God does not have."
• 1962–1965 Catholic Second Vatican Council, announced by Pope John XXIII in 1959, produces 16 documents which become official Roman Catholic teaching after approval by the Pope, purpose to renew "ourselves and the flocks committed to us"
• 1963 Martin Luther King leads a civil rights march in Washington, D.C.
• 1963 A campaign by atheist Madalyn Murray O'Hair results in U.S. Supreme Court ruling prohibiting reading of Bible in public schools
• 1963 Oral Roberts University founded
- 1963 Evangelical Lutheran Synodical Conference of North America dissolves in schism
- 1963 New Testament of Beck's American Translation completed, thousands of copies distributed through The Lutheran Hour
- 1965 Reginald H. Fuller's *The Foundations of New Testament Christology*
- 1965 Rousas John Rushdoony founds Chalcedon Foundation
- 1965 *Nostra aetate* declaration promulgated at Vatican II that repudiates the charge of deicide against Jews
- 1966 Roman Catholic Index of Prohibited Books abolished
- 1966 Raymond E. Brown's *Commentary on the Gospel of John*
- 1967 Lutheran Council in the United States of America organized
- 1968 Zeitoun, Egypt, a bright image of the Virgin Mary as Our Lady of Zeitoun was seen over the Coptic Orthodox Church of Saint Demiana for over a 3-year period. Over six million Egyptians and foreigners saw the image, including Copts, Eastern Orthodox, Roman Catholic, Protestants, Muslims, Jews and people of no particular faith
- 1968 United Methodist Church formed with union of Methodist Church & Evangelical United Brethren Church, becoming the largest Methodist/Wesleyan church in the world
- 1970s The Jesus movement takes hold in the U.S. One-way.org
- 1970 Mass of Paul VI replaces Tridentine Mass
- 1970 The Late, Great Planet Earth, futurist book by Hal Lindsey, published
- 1971 New American Standard Bible
- 1971 *The Exorcist*, a novel of demonic possession and the mysteries of the Catholic faith, is published
- 1971 Liberty University founded by Jerry Falwell
- 1972 Most Lutheran free churches in Germany merge, forming the Independent Evangelical-Lutheran Church
- 1973, June 12- Near the city of Akita, "Our Lady" appeared to Agnes Katsuko Sasagawa. Three messages were given to her over a period 5 months Our Lady of Akita.
- 1973 Trinity Broadcasting Network founded by Paul and Jan Crouch
- 1973 New International Version of the Bible is first published (revised in 1978, 1984), using a variety of Greek texts, Masoretic Hebrew texts, and current English style
- 1973 Walkout at Concordia Seminary begins the Seminex controversy in the LCMS
- 1974 Jim Bakker founds PTL television ministry
- 1975 Bruce Metzger's *Textual Commentary on the Greek New Testament*
• 1976 Anneliese Michel, Bavarian woman, undergoes exorcism against demon possession
• 1976 Suicide by self-immolation of East German pastor Oskar Brüsewitz, leads to mass protests against communism
• 1977 New Perspective on Paul
• 1977 Focus on the Family founded by James Dobson
• 1978 Chicago Statement on Biblical Inerrancy
• 1978–2005 Pope John Paul II: reaffirmed moral traditions (*The Splendor of Truth*)
• 1979 Nova Vulgata replaces Clementine Vulgate
• 1979 Moral Majority founded by Jerry Falwell
• 1979 Jesus (1979 film), most watched movie of all time according to New York Times
• 1979–1982? New King James Version, complete revision of 1611 AV, updates archaisms while retaining style
• 1980 Glacier View Conference: Seventh-day Adventist pastor and professor Desmond Ford is defrocked for questioning the sanctuary doctrine of the church, in a 1979 lecture at Pacific Union College
• 1981 Kibeho, Rwanda reported that "Our Lady" appeared to several teenagers telling them to pray to avoid "rivers of blood" (Marian apparitions)
• 1981 Mother Angelica launches EWTN; it grows to become one of the largest television networks in the world; the operation expands to radio in 1992
• 1981 Institute on Religion and Democracy is founded
• 1981 Pope John Paul II shot by Mehmet Ali Agca; survives and later forgives him
• 1982 Chicago Statement on Biblical Hermeneutics
• 1985 Jesus Seminar founded
• 1985 E. P. Sanders' *Jesus and Judaism* published
• 1986 Chicago Statement on Biblical Application
• 1986 Desmond Tutu becomes Anglican Archbishop of South Africa; joins anti-apartheid movement
• 1987 Danvers Statement – Council on Biblical Manhood and Womanhood
• 1988 Evangelical Lutheran Church in America founded
• 1988 Lutheran Council in the United States of America dissolved
• 1988 Christian Coalition founded by Pat Robertson
• 1988 The Last Temptation of Christ, directed by Martin Scorsese, is released by Universal Pictures, and promptly attacked as heretical by organized Christian and Catholic groups
• 1988 The celebration of 1,000 years since the baptism of Kievan Rus throughout the R.O.C.
• 1988 Assemblies of God pastor Jimmy Swaggart caught in sex scandal
• 1989 New Revised Standard Version
• 1990 American Center for Law and Justice founded
• 1991 John P. Meier's series *A Marginal Jew: Rethinking the Historical Jesus*, v. 1
• 1992 New Catechism of the Catholic Church published
• 1993 Confessional Evangelical Lutheran Conference founded
• 1993 International Lutheran Council founded
• 1994 "Evangelicals & Catholics Together"
• 1994 Porvoo Communion
• 1994 Answers In Genesis founded by Ken Ham
• 1994, July 3- Glorification of St. John of Shanghai and San Francisco
• 1996 Cambridge Declaration – Alliance of Confessing Evangelicals
• 1997, March 5–10- World Council of Churches: Towards a Common Date for Easter, see also Reform of the date of Easter
• 1998, April 6 PBS Frontline: From Jesus to Christ
• 1999 International House of Prayer in Kansas City begins non-stop 24/7 continual prayer
• 1999, October 31- signing of the Joint Declaration on the Doctrine of Justification between the Lutheran World Federation and the Catholic Church
• 1999 Radical Orthodoxy Christian theological movement begins, critiquing modern secularism and emphasizing the return to traditional doctrine; similar to the Paleo-orthodoxy Christian theological movement of the late 20th and early 21st centuries, which sees the consensual understanding of the faith among the Church Fathers as the basis of Biblical interpretation and the foundation of the Church
• 2000 Lutheran Congregations in Mission for Christ founded in schism from Evangelical Lutheran Church in America (ELCA) over fellowship with the Episcopal Church (TEC)
• 2000 Visions of the Virgin Mary are reported in Assiut, Upper Egypt; phenomena associated to Mary is reported again in 2006, in a church at the same location during the Divine Liturgy. Local Coptic priests and then the Coptic Orthodox Church of Assiut issue statements in 2000 and 2006 respectively
21st century

- 2001 The Way of the Master founded
- 2001 Armenia marks 1,700th anniversary of Christianity as its state religion (First country to adopt Christianity as its state religion – Kingdom of Armenia – 301 AD)
- 2003 the Mission Province is established in Church of Sweden: new era for confessional Lutheranism in Scandinavia
- 2005 Death of Pope John Paul II, election of Pope Benedict XVI
- 2006 World Methodist Council votes unanimously to adopt the Joint Declaration on the Doctrine of Justification (July 18).
- 2006 The Jerusalem Declaration on Christian Zionism, signed by several Christian denominations in the Middle East, criticizes the doctrine as associating the Gospel with imperialism and militarism
- 2006 A film of the Gospel of Judas, a 2nd-century Gnostic account of Judas discovered in the 1970s, is shown on TV
- 2007 The Creation Museum opens in Kentucky, United States
- 2007 The American Association of Lutheran Churches and LCMS declare pulpit and altar fellowship
- 2007, May 17 - The Russian Orthodox Church is reunified after 80 years of schism with Russian Orthodox Church Outside Russia a formerly True Orthodox sect that officially become as semi-Autonomous church
- 2007 Pope Benedict XVI issued his motu proprio Summorum Pontificum, which liberalized the use of the traditional Latin Mass
- 2008 Conservative Anglicans indicate that they plan to split from liberal Anglicans in "The Jerusalem Declaration"
- 2009 Damien of Molokai canonized; apostle to lepers
- 2009, August 21 - The Minneapolis Churchwide Assembly of the ELCA passes four ministry policy resolutions that will permit clergy in committed homosexual partnerships to be rostered leaders within the ELCA
- 2009 The Rosicrucian Fellowship, an international association of Esoteric Christian mystics, celebrates the centennial anniversary -- The Fraternity should remain secret one hundred years; the celebration ceremonies, on August 8 and November 13 at Mount Ecclesia, serve the purpose of heralding the revival of the Christian mystic path of the Rose Cross.
- 2009 Mar Varghese Payyappilly Palakkappilly declared Servant of God
- 2009 Manhattan Declaration: A Call of Christian Conscience is issued, signed by over 150 American religious leaders
• 2009 Dr. Frederick Eikerenkoetter (Reverend Ike), a pioneering prosperity preacher, dies
• 2010 Lutheran CORE creates North American Lutheran Church in schism from the ELCA
• 2010, October 31 - Attack on Baghdad church results in 52 deaths
• 2011, January 1 - A church in Alexandria, Egypt is bombed, killing 21 people, mostly Christians
• 2011 Martyrdom of Shahbaz Bhatti, Pakistani politician and the only Christian elected member of the National Assembly, who was an outspoken critic of Pakistan's blasphemy laws
• 2013, March - Pope Francis, an Argentinean, becomes the first non-European pope in modern times. He is also the first pope from the Jesuit order, the first pope from the Americas, and the first pope from the Southern Hemisphere.
• 2015 Coptic Martyrs in Libya
• 2016, 19 June-26 June: The Pan-Orthodox Council at Crete
• 2017, November 5 - A mass shooting occurs at the First Baptist Church in Sutherland Springs, Texas, killing 26 people and injuring 20. The attack is the deadliest mass shooting by an individual in Texas, the fifth-deadliest mass shooting in the United States, as well as the deadliest shooting in an American place of worship in modern history
• 2018, Early October - The Ecumenical Patriarchate of Constantinople has decided to grant autocephaly to proposed Ukrainian Orthodox Church on January 6, 2019.
  o 2018, October 15 - The Russian Orthodox Church has announced it break off relations with the Ecumenical Patriarchate of Constantinople over objections of having communion with then formerly noncanonical Ukrainian Orthodox Churches
  o 2018, December 15 - The Unification council event take places with former Ukrainian Orthodox Churches of UOC-KP, UAOC and parts of UOC-MP to officially merged into unified Ukrainian Orthodox Church.

Timeline of the French Revolution

1788 – The royal treasury is empty; Prelude to the Revolution

• June 7: Day of the Tiles in Grenoble, first revolt against the king.
• July 21: Assembly of Vizille, assembly of the Estates General of Dauphiné.
• August 8: The royal treasury is declared empty, and the Parlement of Paris refuses to reform the tax system or loan the Crown more money. To win their support for fiscal reforms, the Minister of Finance, Brienne,
sets May 5, 1789 for a meeting of the Estates General, an assembly of the nobility, clergy and commoners (the Third Estate), which has not met since 1614.

- August 16: The treasury suspends payments on the debts of the government.
- August 25: Brienne resigns as Minister of Finance, and is replaced by the Swiss banker Jacques Necker, popular with the Third Estate. French bankers and businessmen, who have always held Necker in high regard, agree to loan the state 75 million, on the condition that the Estates General will have full powers to reform the system.
- December 27: Over the opposition of the nobles, Necker announces that the representation of the Third Estate will be doubled, and that nobles and clergymen will be eligible to sit with the Third Estate.

1789 – The Revolution Begins; the Estates-General and the Constituent AssemJanuary

- January: The Abbé Emmanuel Joseph Sieyès publishes his famous pamphlet, "What is the Third Estate?" he writes; "What is the Third Estate? Everything. What has it been until now in the political order? Nothing. What does it demand to be? Something."
- January 24: King Louis XVI convokes elections for delegates to the Estates-General
- April 27: Riots in Paris by workers of the Réveillon wallpaper factory in the Faubourg Saint-Antoine. Twenty-five workers were killed in battles with police.

May

- May 2: Presentation to the King of the Deputies of the Estates-General at Versailles. The clergy and nobles are welcomed with formal ceremonies and processions, the Third Estate is not.
- May 6: The Deputies of the Third Estate refuse to meet separately from the other Estates, occupy the main hall, and invite the clergy and nobility to join them.
- May 11: The nobility refuses to meet together with the Third Estate, but the clergy hesitates, and suspends the verification of its deputies.
- May 20: The clergy renounces its special tax privileges, and accepts the principle of fiscal equality.
- May 22: The nobility renounces its special tax privileges. However, the three estates are unable to agree on a common program.
June

- June 3: The scientist Jean Sylvain Bailly is chosen the leader of the Third Estate deputies.
- June 4: Upon the death of seven-year-old Louis Joseph Xavier François, Dauphin of France, the eldest son and heir of Louis XVI, his four-year-old brother, Louis-Charles, Duke of Normandy, becomes the new Dauphin.
- June 6: The deputies of the nobility reject a compromise program proposed by finance minister Jacques Necker.
- June 10: At the suggestion of Sieyès, the Third Estate deputies decide to hold their own meeting, and invite the other Estates to join them.
- June 13–14: Nine deputies from the clergy decide to join the meeting of the Third Estate.
- June 17: On the proposal of Sieyès, the deputies of the Third Estate declare themselves the National Assembly. To ensure popular support, they decree that taxes need only be paid while the Assembly is in session.
- June 19: By a vote of 149 to 137, the deputies of the clergy join the assembly of the Third Estate.
- June 20: On the orders of Louis XVI, the meeting hall of the Third Estate is closed and locked. At the suggestion of Dr. Joseph-Ignace Guillotin, the deputies gather instead in the indoor tennis court, where they swear not to separate until they have given France a new Constitution (the Tennis Court Oath).
- June 21: The Royal Council rejects the financial program of Minister Necker.
- June 22: The new National Assembly meets in the church of Saint Louis in Versailles. One hundred fifty deputies from the clergy attend, along with two deputies from the nobility.
- June 23: Louis XVI personally addresses the Estates-General (a Séance royale), where he invalidates the decisions of the National Assembly and instructs the three estates to continue to meet separately. The king departs followed by the Second- and most of the First-Estate deputies, but the Third-Estate deputies remain in the hall. When the king's master of ceremonies reminds them that Louis has invalidated their decrees, the Comte de Mirabeau, Third-Estate deputy from Aix, boldly shouts that "we are assembled here by the will of the people" and that they would "leave only at the point of a bayonet".
- June 27: Louis XVI reverses course, instructs the nobility and clergy to meet with the other estates, and recognizes the new Assembly. At the same time, he orders reliable military units, largely composed of Swiss and German mercenaries, to Paris.
- June 30: A crowd invades the prison of the Abbey of Saint-Germain-des-Prés and liberates soldiers who had been imprisoned for attending meetings of political clubs.
July

- July 6: The National Assembly forms a committee of thirty members to write a new Constitution.
- July 8: As tensions mount, the Comte de Mirabeau, Third-Estate deputy from Aix, demands that the Garde Française of the military household of the king of France be moved out of Paris, and that a new civil guard be created within the city.
- July 9: The National Assembly reconstitutes itself as the National Constituent Assembly.

July 14 – The Siege and Surrender of the Bastille

- July 11: Louis XVI abruptly dismisses Necker. Parisians respond by burning the unpopular customs barriers, and invading and looting the monastery of the Lazaristes. Skirmishes between the cavalrmen of the Régiment de Royal-Allemand of the King's Guard and the angry crowd outside the Tuileries Palace. The Garde Française largely take the side of the crowd.
- July 13: The National Assembly declares itself in permanent session. At the Hôtel de Ville, city leaders begin to form a governing committee and an armed militia.
- July 14: Storming of the Bastille. A large armed crowd besieges the Bastille, which holds only seven prisoners but has a large supply of gunpowder, which the crowd wants. After several hours of resistance, the governor of the fortress de Launay, finally surrenders; as he exits, he is killed by the crowd. The crowd also kills de Flesselles, the provost of the Paris merchants.
- July 15: The astronomer and mathematician Jean Sylvain Bailly is named mayor of Paris, and Lafayette is appointed Commander of the newly formed National Guard.
- July 16: The King reinstates Necker as finance minister and withdraws royal troops from the center of the city. The new elected Paris assembly votes the destruction of the Bastille fortress. Similar committees and local militias are formed in Lyon, Rennes, and in other large French cities.
- July 17: The King visits Paris, where he is welcomed at the Hôtel de Ville by Bailly and Lafayette, and wears the tricolor cockade. Sensing what is ahead, several prominent members of the nobility, including the Count of Artois, the Prince de Condé, the Duke of Enghien, the Baron de Breteuil, the Duke of Broglie, the Duke of Polignac and his wife become the first of a wave of émigrés to leave France.
- July 18: Camille Desmoulins begins publication of La France libre, demanding a much more radical revolution and calling for a republic arguing that revolutionary violence is justified.
- July 22: An armed mob on the Place de Grève massacres Berthier de Sauvigny, Intendant of Paris, and his father-in-law, accused of speculating in grain.
July 21-August 1: Riots and peasant revolts in Strasbourg (July 21), Le Mans (July 23), Colmar, Alsace, and Hainaut (July 25).

July 28: Jacques Pierre Brissot begins publication of *Le Patriote français*, an influential newspaper of the revolutionary movement known as the Girondins.

**August**

- August 4: The King appoints a government of reformist ministers around Necker. The Assembly votes to abolish the privileges and feudal rights of the nobility.
- August 7: Publication of "A plot uncovered to lull the people to sleep" by Jean-Paul Marat, denouncing the reforms of August 4 as insufficient and demanding a much more radical revolution. Marat quickly becomes the voice of the most turbulent *sans-culottes* faction of the Revolution.
- August 23: The Assembly proclaims freedom of religious opinions.
- August 24: The Assembly proclaims freedom of speech.

**August 27 – Declaration of the Rights of Man and of the Citizen**

- August 28: The Assembly debates giving the King the power to veto legislation.
- August 30: Camille Desmoulins organizes an uprising at the Palais-Royal to block the proposed veto for the King and to force the King to return to Paris. The uprising fails.
- August 31: The Constitution Committee of the Assembly proposes a two-house parliament and a royal right of veto.
- September 9: The Mayor of Troyes is assassinated by a mob.
- September 11: The National Assembly gives the King the power to temporarily veto laws for two legislative sessions.
- September 15: Desmoulins publishes *Discours de la lanterne aux Parisiens*, a radical pamphlet justifying political violence and exalting the Parisian mob.
- September 16: First issue of Jean Paul Marat's newspaper, *L'Ami du peuple*, proposing a radical social and political revolution.
- September 19: Election of a new municipal assembly in Paris, with three hundred members elected by districts.
October 1: At the banquet des Gardes du Corps du Roi in Versailles, which Louis XVI, Marie-Antoinette and the Dauphin attended at dessert time, the King's guards put on the white royal cocarde. The false news quickly reaches Paris that the guards had trampled on the tricolor and causes outrage.

October 6 – Women's March on Versailles

October 5: Marat's newspaper demands a march on Versailles to protest the insult to the cocarde tricolor. Thousands of women take part in the march, joined in the evening by the Paris national guard led by Lafayette.

October 6: After an orderly march, a crowd of women invade the Palace. The women demand that the King and his family accompany them back to Paris, and the King agrees. The National Assembly also decides to relocate to Paris.

October 10: The Assembly names Lafayette commander of the regular army in and around Paris. The Assembly also modifies the royal title from "King of France and Navarre" to "King of the French". Joseph-Ignace Guillotin, a doctor, member of the Assembly, proposes a new and more humane form of public execution, which eventually is named after him, the guillotine.

October 12: Louis XVI secretly writes to king Charles IV of Spain, complaining of mistreatment. The Count of Artois secretly writes to Joseph II of Austria requesting a military intervention in France.

October 19: The National Assembly holds its first meeting in Paris, in the chapel of the archbishop's residence next to Notre Dame Cathedral.

October 21: The Assembly declares a state of martial law to prevent future uprisings.

November 2: The Assembly votes to place property of the Church at the disposition of the Nation.

November 9: The Assembly moves to the Salle du Manège, the former riding school near the Tuileries Palace.

November 28: First issue of Desmoulins' weekly Histoire des Révolutions de France et de Brabant, savagely attacking royalists and aristocrats.

November: the Breton Club is reconstituted in Paris at the Saint-Honore monastery of Dominicans, who were more popularly known as Jacobins, under the name Society of Friends of the Constitution

December 1: Revolt by the sailors of the French Navy in Toulon, who arrest Admiral d'Albert.

December 9: The Assembly decides to divide France into departments, in place of the former provinces of France.

December 19: Introduction of the assignat, a form of currency based not on silver, but on the value of the property of the Church confiscated by the State.
- December 24: The Assembly decrees that Protestants are eligible to hold public office; Jews are still excluded.

1790 – the Rise of the Political Clubs

- January 7: Riot in Versailles demanding lower bread prices.
- January 18: Marat publishes a fierce attack on finance minister Necker.
- January 22: Paris municipal police try to arrest Marat for his violent attacks on the government, but he is defended by a crowd of sans-culottes and escapes to London.
- February 13: The Assembly forbids the taking of religious vows and suppresses the contemplative religious orders.
- February 23: The Assembly requires curés (parish priests) in churches across France to read aloud the decrees of the Assembly.
- February 28: The Assembly abolishes the requirement that army officers be members of the nobility.
- March 8: The Assembly decides to continue the institution of slavery in French colonies, but permits the establishment of colonial assemblies.
- March 12: The Assembly approves the sale of the property of the church by municipalities
- March 29: Pope Pius VI condemns the Declaration of the Rights of Man in a secret consistory.
- April 5-June 10: A series of pro-catholic and anti-revolutionary riots in the French provinces; in Vannes (April 5), Nîmes (April 6), Toulouse (April 18), Toulon (May 3), and Avignon (June 10) protesting measures taken against the church.
- April 17: Foundation of the Cordeliers club, which meets in the former convent of that name. It becomes one of most vocal proponents of radical change.
- April 30: Riots in Marseille. Three forts are captured, and the commander of Fort Saint-Jean, the Chevalier de Beausset, is assassinated.
- May 12: Lafayette and Jean Sylvain Bailly institute the Society of 1789.
- May 15: Law passed that allows for the redemption of manorial dues
- May 18: Marat returns to Paris and resumes publication of L'Ami du peuple.
- May 22: The Assembly decides that it alone can decide issues of war and peace, but that the war cannot be declared without the proposition and sanction by the King.
- June 3: Uprising of biracial residents of the French colony of Martinique.
June 19: The Assembly abolishes the titles, orders, and other privileges of the hereditary nobility.

June 26: Avignon, then under the rule of the Pope, asks to be joined to France. The Assembly, wishing to avoid a confrontation with Pope Pius VI, delays a decision.

June 26: Diplomats of England, Austria, Prussia and the United Provinces meet at Reichenbach to discuss possible military intervention against the French Revolution.

July 12: The Assembly adopts the final text on the status of the French clergy. Clergymen lose their special status, and are required to take an oath of allegiance to the government.

July 14 – *Fête de la Fédération*

- July 14: The *Fête de la Fédération* is held on the *Champ de Mars* in Paris to celebrate the first anniversary of the Revolution. The event is attended by the king and queen, the National Assembly, the government, and a huge crowd. Lafayette takes a civic oath vowing to "be ever faithful to the nation, to the law, and to the king; to support with our utmost power the constitution decreed by the National Assembly, and accepted by the king." This oath is taken by his troops, as well as the king. The *Fête de la Fédération* is the last event to unite all the different factions in Paris during the Revolution.

- July 23: The Pope writes a secret letter to Louis XVI, promising to condemn the Assembly's abolition of the special status of the French clergy.

- July 26: Marat publishes a demand for the immediate execution of five to six hundred aristocrats to save the Revolution.

- July 28: The Assembly refuses to allow Austrian troops to cross French territory to suppress an uprising in Belgium, inspired by the French Revolution.

- July 31: The Assembly decides to take legal action against Marat and Camille Desmoulins because of their calls for revolutionary violence.

- August 16: The Assembly establishes positions of justices the peace around the country to replace the traditional courts held by the local nobles.

- August 16: The Assembly calls for the re-establishment of discipline in the army.

- August 31: Battles in Nancy between rebellious soldiers of the army and the national guard units of the city, who support Lafayette and the Assembly.

- September 4: Necker, the finance minister, is dismissed. The National Assembly takes charge of the public treasury.

- September 16: Mutiny of sailors of the French fleet at Brest.

- October 6: Louis XVI writes his cousin, Charles IV of Spain, to express his hostility to the new status of the French clergy.
October 12: The Assembly dissolves the local assembly of Saint-Dominque (now Haiti) and again reaffirms the institution of slavery.

October 21: The Assembly decrees that the tricolor will replace the white flag and fleur-de-lys of the French monarchy as emblem of France.

November 4: Insurrection in the French colony of Isle de France (now Mauritius).

November 25: Uprising of black slaves in the French colony of Saint-Domingue (now Haiti).

November 27: The Assembly decrees that all members of the clergy must take an oath to the Nation, the Law and the King. A large majority of French clergymen refuse to take the oath.

December 3: Louis XVI writes to King Frederick William II of Prussia asking for a military intervention by European monarchs to restore his authority.

December 27: Thirty-nine deputies of the Assembly, who are also clergymen, take an oath of allegiance to the government. However, a majority of clergymen serving in the Assembly refuse to take the oath.

1791 – The unsuccessful flight of the Royal Family from Paris

- January 1: Mirabeau elected President of the Assembly
- January 3: Priests are ordered to take an oath to the Nation within twenty-four hours. A majority of clerical members of the Assembly refuse to take the oath.
- February 19: Mesdames, the daughters of Louis XV and aunts of Louis XVI, depart France for exile.
- February 24: Constitutional bishops, who have taken an oath to the State, replace the former Church hierarchy.
- February 28: Day of Daggers. Lafayette orders the arrest of 400 armed aristocrats who have gathered at the Tuileries Palace to protect the royal family. They are freed on March 13.
- March 2: Abolition of the traditional trade guilds.
- March 3: The Assembly orders that the silver objects owned by the Church be melted down and sold to fund the government.
- March 10: Pope Pius VI condemns the Civil Constitution of the Clergy
- March 25: Diplomatic relations broken between France and the Vatican.
- April 2: Death of Mirabeau.
- April 3: The Assembly proposes transforming the new church of Sainte Geneviève, not yet consecrated, into the Panthéon, a mausoleum for illustrious citizens of France. On May 4, the remains of Mirabeau are the first to be placed in the new Panthéon.
- April 13: Encyclical of Pope Pius VI condemns the Civil Constitution of the Clergy.
April 18: The National Guard, despite orders from Lafayette, blocks the royal family from going to the *Château de Saint-Cloud* to celebrate Easter.

May 16: On a proposal of Robespierre, the Assembly votes to forbid members of the current Assembly to become candidates for the next Assembly.

May 30: The Assembly orders the transfers of the ashes of Voltaire to the Panthéon.

June 14: The Chapelier Law is passed by the Assembly, abolishing corporations and forbidding labor unions and strikes.

June 15: The Assembly forbids priests to wear ecclesiastical costumes outside churches.

### June 20–21 – The Royal Family flees Paris

- June 20–21: The Flight to Varennes. In the night of 20–21 June, the King, the Queen and their children slip out of the Tuileries Palace and flee by carriage in the direction of Montmédy.
- June 21–22: The King is recognized at Varennes. The Assembly announces that he was taken against his will, and sends three commissioners to bring him back to Paris.
- June 25: Louis XVI returns to Paris. The Assembly suspends his functions until further notice.
- July 5: Emperor Leopold II issues the Padua Circular calling on the royal houses of Europe to come to the aid of Louis XVI, his brother-in-law.
- July 9: The Assembly decrees that *émigrés* must return to France within two months, or forfeit their property.
- July 11: The ashes of Voltaire are transferred to the *Panthéon*.
- July 15: National Assembly declares the king inviolable, and cannot be put on trial. Louis XVI suspended from his duties until the ratification of a new Constitution.
- July 16: The more moderate members of the Jacobins club break away to form a new club, the Feuillants.
- July 17: A demonstration sponsored by the Jacobins, Cordeliers and their allies carries a petition demanding the removal of the King to the *Champ de Mars*. The city government raises the red flag, the sign of martial law, and forbids the demonstration. The National Guard fires on the crowd, and some fifty persons are killed.
- July 18: Following the events in the *Champ de Mars*, the Assembly forbids incitement to riot, urging citizens to disobey the law, and seditious publications, aimed at the Jacobins and Cordeliers. Marat goes into hiding and Danton flees to England.
August 14: Slave uprising begins in Saint Domingue (Haiti)

August 27: Declaration of Pillnitz - A proclamation by Frederick William II of Prussia and Habsburg Holy Roman Emperor Leopold II, affirms their wish to "put the King of France in a state to strengthen the bases of monarchic government." This vague statement is taken in France as a direct threat by the other European powers to intervene in the Revolution.

September 13–14: Louis XVI formally accepts the new Constitution.

September 27: The Assembly declares that all men living in France, regardless of color, are free, but preserves slavery in French colonies. French Jews are granted citizenship.

September 29: The Assembly limits membership in the National Guard to citizens who pay a certain level of taxes, thus excluding the working class.

September 30: Last day of the National Constituent Assembly. Assembly grants amnesty to all those punished for illegal political activity since 1788.

October 1: First session of the new national Legislative Assembly. Claude Pastoret, a monarchist, is elected President of the assembly.

October 16: Riots against the revolutionary commune, or city government, in Avignon. After an official of the commune is killed, anti-government prisoners kept in the basements of the Papal Palace are massacred.

November 9: Émigrés are again ordered to return to France before January 1, 1792, under penalty of losing their property and a sentence of death. King Louis XVI vetoes the declaration on November 11, but asks his brothers to return to France.

November 14: Jérôme Pétion de Villeneuve is elected mayor of Paris, with 6,728 votes against 3,126 for Lafayette. Out of 80,000 eligible voters, 70,000 abstain.

November 25: The Legislative Assembly creates a Committee of Surveillance to oversee the government.

November 29: Priests are again ordered to take an oath to the government, or to be considered suspects.

December 3: The King writes a secret letter to Frederick William II of Prussia, urging him to intervene militarily in France "to prevent the evil which is happening here before it overtakes the other states of Europe.

December 3: Louis XVI's brothers, (the counts of Provence and Artois) refuse to return to France, citing "the moral and physical captivity in which the King is being held."

December 14: Lafayette receives command of one of the three new armies established to defend the French borders, the Army of the Centre, based at Metz. The other two armies are commanded by Rochambeau (Army of the North) and Nicolas Luckner (Army of the Rhine).

December 28: The Assembly votes to summon a mass army of volunteers to defense the borders of France,
1792 – War and the overthrow of the monarchy

- 23 January: The slave uprising in Haiti causes severe shortages of sugar and coffee in Paris. Riots against food shortages; many food shops are looted. January–March: Food riots in Paris
- February 1: French citizens are required to have a passport to travel in the interior of the country.
- February 7: Austria and Prussia sign in Berlin a military convention to invade France and defend the monarchy.
- February 9: The Assembly decrees the confiscation of the property of émigrés, for the benefit of the Nation.
- February 23: Confrontation between the army and crowds in Béthune over the allocation of grain.
- March 7: The Duke of Brunswick is named to command a joint Austrian-Prussian invasion of France.
- April 4: The Assembly granted equal rights to free people of color in Haiti.
- April 5: The Assembly closes the Sorbonne, a center of conservative theology.
- April 20: The Assembly declares war on the King of Bohemia and Hungary, i.e. to the Holy Roman Empire.
- April 25: La Marseillaise composed by Claude Joseph Rouget de Lisle, is sung for the first time in Strasbourg.
- April 28: The war begins. The army of Rochambeau invades the Austrian Netherlands.
- April 30: The government issues three hundred million assignats to finance the war.
- May 5: The Assembly orders the raising of thirty-one new battalions for the army.
- May 6: The Royal-Allemand regiment (Régiment de Royal-Allemand cavalerie), composed of German mercenaries, deserts the French army and joins the Austrian-Prussian coalition.
- May 12: The Hussar regiments of Saxe and Bercheny desert the French Army and join the coalition.
- May 27: The Assembly orders the deportation of priests who have not signed the oath to the government, known as the Civil Constitution of the Clergy.
- June 8: The Assembly orders the raising of an army of twenty thousand volunteers to be camped outside Paris.
- June 11: Louis XVI vetoes the laws on the deportation of priests and the formation of a new army outside Paris.
- June 20: A secret insurrectionary committee, supported by the Paris Commune and led by the prosecutors Louis Pierre Manuel and Georges Danton, is formed.
- June 20: Demonstrators invade the Tuileries Palace and king Louis XVI condescends to wear a red liberty cap and drink to the health of the Nation.
• June 21: The Assembly bans gatherings of armed citizens within the city limits.

• June 28: Lafayette speaks to the Assembly, denouncing the actions of the Jacobins and other radical groups in the Assembly. His proposal to organize a review of the National guard in Paris is annulled by Pétion, mayor of Paris.

• June 30: Lafayette leaves Paris and returns to his army. He is denounced by Robespierre and his effigy is burned by a mob at the Palais-Royal.

• July 11: As the Austrian army advances slowly toward Paris, the Assembly declares that the Nation is in danger (La patrie en danger).

• July 15: The Assembly votes to send regular army units, whose officers largely support Lafayette, far outside the city.

• July 15: Members of the Cordeliers club, led by Danton, demand the convocation of a Convention to replace the Legislative Assembly.

• July 25: The Assembly authorizes the Paris sections, local assemblies in each neighborhood, many controlled by the Jacobins and Cordeliers, to meet in permanent sessions.

• July 25: Brunswick Manifesto - The Austrian commander warns that should the royal family be harmed, an "exemplary and eternally memorable revenge" will follow.

• July 28: The Brunswick Manifesto is widely circulated in Paris, causing fury against the King.

• July 30: Decree by the Assembly allows working-class citizens (those who pay no taxes) to join the National Guard.

• July 30: Arrival in Paris of volunteer fédérés from Marseille. They sing the new war hymn, of the Army of the Rhine, which gradually takes their name, La Marseillaise. Fights break out between the new volunteers and soldiers of the National Guard loyal to Lafayette.

• August 3: 47 of the 48 sections of Paris, mostly controlled by the Cordeliers and the Jacobins, send petitions to the Assembly, demanding the removal of the King. They are presented by Pétion, the mayor of Paris.

• August 4: The Paris section Number Eighty proclaims an insurrection on August 10 if the Assembly does not remove the King. At the request of the royal household, the Swiss guards at the Tuileries are reinforced, and joined by many armed nobles.

• August 9: Georges Danton, a deputy city prosecutor, and his Cordeliers allies take over the Paris city government and establish the Revolutionary Paris commune. They take possession of the Hôtel de Ville. They increase the number of Commune deputies to 288. The Assembly recognizes them as the legal government of Paris on August 10.
August 10 – Storming of the Tuileries; Downfall of the King

- August 10: Storming of the Tuileries Palace. The National Guard of the insurrectional Paris Commune and revolutionary fédérés from Marseille and Brittany attack the Tuileries Palace. The King and his family take refuge in the Legislative Assembly. The Swiss Guards defending the Palace are massacred. The Legislative Assembly provisionally suspends the authority of the King, and orders the election of a new government, the Convention.

- August 11: The Assembly elects a new Executive Committee to replace the government. Danton is named Minister of Justice. The municipalities are authorized to arrest suspected enemies of the Revolution, and royalist newspapers and publications are banned.

- August 13: Royal family imprisoned in the Temple.

- August 14: Lafayette tries unsuccessfully to persuade his army to march on Paris to rescue the royal family.

- August 17: At the demand of Robespierre and the Commune of Paris, who threatens an armed uprising if the Assembly does not comply, the Assembly votes the creation of a Revolutionary Tribunal, the members of which are selected by the Commune, and the summoning of a National Convention to replace the Assembly.

- August 18: The Assembly abolishes the religious teaching orders and those running hospitals, the last remaining religious orders in France.

- August 19: Lafayette leaves his army and goes into exile. The Coalition army of Austrian and Prussian soldiers, and of French émigrés, led by the Duke of Brunswick crosses the northern and eastern borders into France.

- August 21: First summary judgement by the Revolutionary Tribunal and execution by the guillotine of a royalist, Louis Collenot d'Angremont (fr).

- August 22: The Paris Commune orders that persons henceforth be addressed as Citoyen and Citoyenne ("Citizen") rather than Monsieur or Madame.

- September 2: Royalist riots in Brittany, Vendée and Dauphiné.

- September 2: Capitulation without a fight of Verdun to Brunswick's troops.

September 2–7 – Massacres in Paris prisons

- September 2–7: Following the news of surrender of Verdun, the Commune orders massacres of prisoners in Paris prisons. Between 1400 and 2000 prisoners are massacred, the great majority were common criminals, 17 percent were priests, 6 percent Swiss guards, and 5 percent political prisoners.

- September 10: The government requisitions all church objects made of gold or silver.

- September 19: Creation of the Louvre Museum displaying art taken from royal collections.
• September 20: Last session of Assembly votes a new law permitting civil marriage and divorce.

**September 20 – French victory at Valmy; Debut of the Convention**

• September 20: The French army under Generals Dumouriez and Kellermann defeat the Prussians at the Battle of Valmy. The Prussians retreat.

• September 20: The newly elected National Convention holds its first session behind closed doors, in the Salle du Manège, the former riding school of the Tuileries Palace, and elects its Bureau. Of the 749 deputies, 113 are Jacobins, who take their seats in the highest benches in the hall, the Montagne (Mountain), thus their nickname of Montagnards, the "Mountaineers".

• September 22: The Convention proclaims the abolition of royalty and the First French Republic.

• September 29: French troops occupy Nice, then part of Savoy.

• October 3: French troops occupy Basel in Switzerland, then ruled by Archbishop of Basel, and proclaim it an independent Republic.

• October 23: French troops occupy Frankfurt am Main.

• October 27: The French army under Dumouriez invades the Austrian Netherlands (Belgium). They occupy Brussels on November 14.

• November 19: The Convention claims the right to intervene in any country "where people desire to recover their freedom".

• November 20: Discovery in the king's apartment in the Tuileries Palace of the armoire de fer, an iron strongbox containing Louis XVI's secret correspondence with Mirabeau and with foreign monarchs.

• November 27: The Convention decrees the attachment of Nice and the Savoy to France.

• November 28: The French army occupies Liège.

• December 3: Robespierre, leader of the Jacobins and First Deputy for Paris in the Convention, demands that the King be put to death.

• December 4: Deputies sent by Brussels assembly to the National Convention express gratitude of the Belgian people and request that France officially recognise the independence of Belgium. The Convention adopts immediately the proposed decree.

• December 6: At the proposal of Jean-Paul Marat, the Convention rules that each deputy must individually and publicly declare his vote on the death penalty for the King.

**December 10, 1792-January 21, 1793 – Trial and Execution of Louis XVI**

• December 10: Opening of the trial of Louis XVI before the Convention.
• December 11: Louis XVI is brought before the Convention. He appears in person twice, December 11 and 26.

• December 26: Defense of the King presented by his lawyer, Raymond Desèze (Raymond comte de Sèze).

• December 27–28: Motions in the Convention asking that people vote on judgement of the King. The motion is opposed by Robespierre, who declares "Louis must die so that the nation may live." The Convention rejects the motion for French voters to decide the King's fate.

• January 15: The Convention declares Louis XVI guilty of conspiracy against public liberty by a vote of 707 to zero.

• January 17: In a vote lasting twenty-one hours, 361 deputies vote for the death penalty, and 360 against (including 26 for a death penalty followed by a pardon). The Convention rejects a final appeal to the people.

• January 21: Louis XVI is beheaded at 10:22 on Place de la Révolution. The commander of the execution, Antoine Joseph Santerre, orders a drum roll to drown out his final words to the crowd.

1793 – France at war against Europe; The Jacobins seize power; The Terror begins

• January 21: Louis XVI, at age 38, was beheaded by guillotine on the Place de la Révolution.

• January 24: Breaking of diplomatic relations between England and France.

• February 1: The Convention declares war against England and the Dutch Republic.

• February 14: The Convention annexes the Principality of Monaco.

• February 14: Jean Nicolas Pache is elected the new mayor of Paris.

• March 1: Decree of the Convention annexes Belgium to France.

• March 3: Armed royalist uprising against the Convention begins in Brittany.

• March 7: The Convention declares war against Spain.

Uprising in the Vendée

• March 7: War in the Vendée. Armed uprising against the rule of the Convention, particularly against conscription into the army, begins in the Vendée region of west-central France.

• March 10: Revolutionary Tribunal established in Paris, with Fouquier-Tinville as the public prosecutor.
March 10: Failed uprising in Paris by the ultra-revolutionary faction known as the enragés, led by the former priest Jacques Roux.

March 18: The Convention decrees the death penalty for those advocating radical economic programs, a decree aimed at the enragés.

March 19: The Convention decrees the death penalty for any participant in the uprising in the Vendée.

March 21: Establishment of Revolutionary Surveillance Committees (Comités de surveillance révolutionnaire) in all communes and their sections.

March 27: General Dumouriez denounces revolutionary anarchy.

March 30: The Convention orders Dumouriez to return to Paris, and sends four commissaires and Pierre de Ruel, the Minister of War, to arrest him.

April 1: Dumouriez arrests the commissaires of the Convention and Minister of War and hands them over to the Austrians.

April 3: Convention declares Dumouriez outside the law.

April 3: Arrest of Philippe Égalité, a deputy and head of the Orléans branch of the royal family, who had voted for the execution of Louis XVI, his cousin.

April 4: Dumouriez fails to persuade his army to march on Paris, and goes over to the Austrians on April 5.

April 5: Jean Paul Marat is elected head of the Jacobin Club.

April 6–May 30 - Committee on Public Safety takes control of government

April 6: Committee of Public Safety established by the Convention to oversee the ministries and to be chief executive body of the government. Its first nine members included Bertrand Barère, Pierre Joseph Cambon and Georges Danton.

April 6: First session of the Revolutionary Tribunal.

April 12: The Convention votes to arrest Marat for using his newspaper L'Ami du peuple to incite violence and murder, and demand to suspend the Convention. Marat goes into hiding.

April 15: The mayor of Paris, Jean Nicolas Pache, demands that the Convention expel 23 deputies belonging to the moderate Girondin faction.

April 24: Marat is brought before the Revolutionary Tribunal, and is acquitted of all charges. His release causes riotous celebrations by his supporters.

May 3: The rebels of the Vendée, led by the aristocrats Charles de Bonchamps and Henri de La Rochejaquelein, capture Bressuire.
May 4: At the demand of the Paris section of Saint-Antoine, the Convention fixes a maximum price for grain.

May 24: At the demand of the Girondins, the Convention orders the arrest of the ultra-revolutionary enragés leaders Jacques René Hébert and Jean Varlet.

May 25: The Paris Commune demands the release of Hébert and Varlet.

May 26: At the Jacobin Club, Robespierre and Marat call for an insurrection against the Convention. The Paris Commune begins preparing a seizure of power.

May 27: Release of Hébert and Varlet.

May 30: The leaders of Lyon rebel against the Convention, arresting the local Montagnard and enragés leaders.

May 31-June 2 – The Jacobin Coup d'État

- May 31: Insurrection of 31 May – 2 June 1793. An armed crowd of sans-culottes organized by the Commune storms the hall of the Convention and demands that it disband. The deputies resist.
- June 2: The sans-culottes and soldiers of the Paris Commune, led by François Hanriot, occupy the hall of the Convention and force it to vote for the arrest of 29 Girondins deputies, and two ministers, Clavière and Lebrun.
- June 6: Revolts against the Montagnard coup d'état in Marseille, Nîmes, and Toulouse. Bordeaux.
- June 7: Bordeaux rejects the new government.
- June 10: Montagnards gain control of the Committee of Public Safety.
- June 10: Despite the Revolution, scientific research continues. Opening of the National Museum of Natural History.
- June 24: Ratification of new Constitution by the National Convention.
- June 25: Jacques Roux, leader of the ultra-revolutionary enragés, presents his program to the Convention.
- June 26: Robespierre denounces the enragés before the Convention.
- June 30: Robespierre and Hébert lead a delegation of Jacobins to the Cordeliers Club to demand the exclusion from the club of Roux and the other ultra-revolutionary leaders.
- July 3: The eight-year-old Louis XVII, king of France in the eyes of the royalists, is taken from Marie Antoinette and given to a cobbler named Antoine Simon on orders from the National Convention.
July 4: Marat violently denounces the *enragés.*

July 13 – Assassination of Jean-Paul Marat by Charlotte Corday

- July 13: Charlotte Corday assassinates Jean-Paul Marat in his bath. At her trial, she declares, "I killed one man to save a hundred thousand."
- July 17: Charlotte Corday is tried and sentenced to death by the Revolutionary Tribunal for murdering Marat. She is guillotined after her trial.
- July 27: Robespierre elected to the Committee of Public Safety.
- August 1: The Convention declares a scorched earth policy against all departments rebelling against its authority.
- August 1: The Convention adopts the principles of the metric system.
- August 1: On order by decree of the Convention, a mob profanes the tombs of the Kings of France at the Basilica of Saint-Denis.
- August 2: Marie-Antoinette is transferred from the Temple to the Conciergerie.
- August 8: The Convention sends an army led by General Kellermann to lay siege to the rebellious city of Lyon.
- August 22: Robespierre is elected the president of the Convention.
- August 23: *Levée en masse* voted by the Convention. All able-bodied non-married men between ages 18 and 25 are required to serve in the army.
- August 27: Anti-Convention leaders in Toulon invite the British fleet and army to occupy the city.
- September 4: *Sans-culottes* occupy the Convention and demand the arrest of suspected opponents of the Revolution, and the creation of a new revolutionary army of 60,000 men.

September 17 – The Reign of Terror begins

- September 17: Convention adopts a new Law of Suspects, permitting the arrest and rapid trial of anyone suspected of opposing the Revolution. Start of Reign of Terror.
- September 18: Convention re-establishes revolutionary government in Bordeaux. Opponents are arrested and imprisoned.
- September 21: All women are required to wear a *cocarde tricolor.*
- September 29: The Convention passes the General Maximum, fixing the prices of many goods and services, as well as maximum salaries.

- October 3: The Convention orders that Marie-Antoinette be tried by the Revolutionary Tribunal.

- October 3: Additional moderate deputies are accused and excluded from the Assembly; a total of 136 deputies are excluded.

- October 5: To break with the past and replace traditional religious holidays, the Convention adopts the newly created Republican Calendar: Year I is declared to have begun on September 22, 1792.

- October 9: Lyon is recaptured by the army of the Convention.

- October 10: A decree by the Convention puts the new Constitution on hold. On a proposal from Saint-Just, the Convention declares that "The government of France is revolutionary until the peace."

- October 12: The Convention decrees that the city of Lyon will be destroyed in punishment for its rebellion, and renamed Ville-Affranchie.

- October 12: Marie-Antoinette is summoned before the Revolutionary Tribunal and charged with treason.

- October 16: The Army of the Convention defeats the Austrian Army at the Battle of Wattignies.

- October 16: Marie-Antoinette is convicted and guillotined on the Place de la Revolution.

- October 17: The Army of the Convention under Generals Jean-Baptiste Kléber and François Séverin Marceau-Desgraviers defeats the Vendéen rebels at Cholet.

- October 20: The Convention orders the repression of the ultra-revolutionary enragés.

- October 28: The Convention forbids religious instruction by clerics.

- October 30: The Revolutionary Tribunal sentences the 21 Girondins deputies to death.

- October 31: The 21 Girondins deputies are guillotined.

- November 3: Olympe de Gouges, champion of rights for women, accused of Girondin sympathies, is guillotined.

- November 7: Philippe Égalité is guillotined.

- November 8: Madame Roland is guillotined in the purge of Girondins. Before her execution, she cries: "Liberty, what crimes are committed in your name!"

- November 9: Former finance minister Brienne is arrested at Sens.

**October 16 – The execution of Marie-Antoinette**

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- November 9: Former finance minister Brienne is arrested at Sens.
November 10: The Cathedral of Notre Dame is re-dedicated as a Temple of Reason in to the civic religion of the Cult of Reason.

November 12: The astronomer and former mayor of Paris, Jean Sylvain Bailly, is executed on the Champ de Mars for his role in suppressing a demonstration there on July 17, 1791.

November 17: On Robespierre's orders, supporters of Danton are arrested.

November 20: Danton returns to Paris, after being absent since October 11. He urges "indulgence" toward opponents and "national reconciliation".


November 25: Convention votes to remove Mirabeau's remains from the Panthéon and replace them with those of Marat.

December 5: The Cordelier deputy Camille Desmoulins, supporting Danton, publishes an appeal for national reconciliation.

December 12: Defeat of the rebel Vendéen army at Le Mans.

December 19: Withdrawal of the British from Toulon, following a successful military operation conceived and led by a young artillery officer, Napoléon Bonaparte.

December 23: The Army of General François Joseph Westermann destroys the last the Vendéen army at Savenay. Six thousand prisoners are executed.

December 24: To punish the rebellious city of Toulon, the Convention renames it Port-la-Montagne.

1794 – The fury of the Terror, the Cult of the Supreme Being, and the Downfall of Robespierre

January 8: At the Jacobins, Robespierre denounces Fabre d'Églantine, one of the instigators of the September massacres, father of the Republican calendar, and ally of Danton.

January 13: Arrest of Fabre d'Églantine for alleged diversion of state funds.

January 29: Death of Henri de la Rochejaquelein, royalist and military leader of the Vendéens, fighting at Nuillé.

February 4: The Convention votes to abolish slavery in French colonies.

February 5: Robespierre lectures the Convention on the necessity for the Terror: "The foundations of a popular government in a revolution are virtue and terror; terror without virtue is disastrous; and virtue without terror is powerless. The Government of the Revolution is the despotism of liberty over tyranny."

February 6: Napoleon Bonaparte is promoted to general for his role in driving the British from Toulon,
February 6: Recall of Jean-Baptiste Carrier from Nantes. As official delegate of the Convention, he was responsible for the drownings at Nantes of as many as ten thousand Vendéen prisoners, in barges deliberately sunk in the Loire River.

February 10: Jacques Roux commits suicide in prison.

February 22: In a speech at the Cordeliers Club, Hébert attacks both the factions of Danton and Robespierre.

March 4: At the Cordeliers Club, Jean-Baptiste Carrier calls for an insurrection against the Convention.

March 11: The Committees of Public Safety and General Security denounce a planned uprising by the Cordeliers.

March 13: Saint-Just, President of the Convention, denounces a plot against liberty and the French people. Hébert and many other Cordeliers are arrested.

March 15: Robespierre tells the Convention that "All the factions must perish from the same blow."

March 17: At the Cordeliers Club, Hébert and many other Cordeliers are arrested.

March 19: Saint-Just, President of the Convention, denounces a plot against liberty and the French people. Hébert and many other Cordeliers are arrested.

March 21: Trial of the Hébertists begins. To compromise them, they are tried together with foreign bankers, aristocrats and counter-revolutionaries.

March 23: Hébert and leaders of the Cordeliers are condemned to death and guillotined.

March 27: The philosopher and mathematician Condorcet is arrested. He is found dead in his cell two days later.

March 30 – The arrest and trial of Danton and Desmoulins

March 30: Danton, Camille Desmoulins and their supporters arrested.

April 1: Robespierre creates a new Bureau of Police attached to the Committee of Public Safety, in opposition to the existing police under the Committee of General Safety.

April 2: Trial of Danton before the Revolutionary Tribunal. He uses the occasion to ridicule and insult his opponents.

April 4: The Convention decrees that anyone who insults the justice system is excluded from speaking, barring Danton from defending himself.

April 5: Danton and Desmoulins are convicted and guillotined the same day.

April 8: Robespierre makes accusations against the Convention delegate Joseph Fouché at a meeting of the Jacobins.
April 10: The members of the alleged Conspiracy of Luxembourg, a diverse collection of followers of Danton and Hébert and other individuals, are put on trial. Seven are acquitted and nineteen are condemned and executed, including Lucile Desmoulins, the widow of Camille Desmoulins, General Arthur Dillon, who had fought in the American Revolutionary War, Pierre Gaspard Chaumette, Françoise Hébert, the widow of Jacques Hébert, and the defrocked Bishop Gobel.

April 14: At the request of Robespierre, the Convention orders the transfer of the ashes of Jean-Jacques Rousseau to the Panthéon.

April 15: A report to the Convention by Saint-Just calls for greater centralization of the police under the control of the Committee for Public Safety.

April 19: By the Treaty of the Hague, between Britain and Prussia, Britain agrees to fund an army of 62,000 Prussian soldiers to continue the war against France.

April 20: In a report to the Convention, the deputy Billaud-Varenne delivers a veiled attack against Robespierre: "All people jealous of their liberty should be on guard even against the virtues of those who occupy eminent positions."

April 26: Divisions within the Committee of Public Safety between Saint-Just and Lazare Carnot. Saint-Just accuses Carnot of links with aristocrats and threatens him with the guillotine, while Carnot calls Saint-Just a ridiculous dictator.

May 7: Robespierre asks the Convention to decree "that the French people recognize the existence of a Supreme Being and the immortality of the soul", and to organize celebrations of the new cult.

May 8: The chemist Antoine Lavoisier, along with twenty-six other former members of the Ferme générale, is tried and guillotined.

May 10: Arrest of Jean Nicolas Pache, the former mayor of Paris, followed by his replacement by Jean-Baptiste Fleuriot-Lescot, a close ally of Robespierre.

May 10: Execution of Madame Élisabeth, the sister of Louis XVI.

June 2: Naval battle between British and French fleets off Ouessant. The French lose seven warships, but a convoy carrying grain from the United States is able to dock in Brest.

June 4: Robespierre is unanimously elected president of the Convention.

June 8 – Festival of the Supreme Being; Acceleration of the Terror

June 8: Festival of the Supreme Being, conducted by Robespierre. Some deputies visibly show annoyance with his behavior at the Festival.

June 10: Law of 22 Prairial - As the prisons are full, the Convention speeds up the trials of those accused. Witnesses are no longer required to testify. From June 11 to July 27, 1,376 prisoners are sentenced to death,
with no acquittals, compared with 1251 death sentences in the previous fourteen months. The Convention also gives itself the exclusive right to arrest its own members.

- June 12: Without naming names, Robespierre announces to the Convention that he will demand the heads of "intriguer" who are plotting against the Convention.
- June 26: French forces under Jourdan defeat the Austrians at the Battle of Fleurus.
- June 29: Dispute within the Committee of Public Safety. Billau-Varenne, Carnot and Collot d'Herbois accuse Robespierre of behaving like a dictator. He leaves the Committee and does not return before July 23.
- July 1: Robespierre speaks at the Jacobin Club, denouncing a conspiracy against him within the Convention, the Committee of Public Safety, and the Committee of General Security.
- July 8: French forces under Generals Jourdan and Pichegru capture Brussels from Austrians.
- July 9: Robespierre speaks again at the Jacobin Club, denying he has already made lists, and refusing to name those he plans to arrest.
- July 14: At the request of Robespierre, Joseph Fouché is expelled from the Jacobin Club.
- July 23: Alexandre de Beauharnais, the husband of Napoleon's future wife Joséphine, is tried and executed.
- July 23: Robespierre attends a meeting of reconciliation with the members of the Committees of Public Safety and General Security, and the dispute seems settled.
- July 25: The poet André Chénier is among those guillotined.

**July 26–28 – Arrest and execution of Robespierre; End of the Terror**

- July 26: Robespierre gives a violent speech at the Convention, demanding, without naming them, the arrest and punishment of "traitors" in the Committees of Public Safety and General Security. The Convention first votes to publish the speech, but Billau-Varenne and Cambon demand names and attack Robespierre. The Convention sends Robespierre's speech to the Committees for further study, without action.
- July 27: The Convention votes the arrest of Robespierre, and of his younger brother Augustin Robespierre, Saint-Just, Couthon and Lebas. Once outside the hall, they are quickly freed by Hanriot and his supporters from the Paris Commune and hurry to the Hôtel de Ville to organize a counter-attack. They expect crowds of supporters to join them during the night, but few supporters arrive.
- July 28: At two in the morning, soldiers loyal to the Convention take the Hôtel de Ville without a fight. Robespierre is wounded in the jaw by a gunshot, either from a gendarme or self-inflicted. His brother is badly injured falling or jumping from the window. In the morning, Robespierre and his supporters are taken to the Revolutionary Tribunal for formal identification. Since they have been declared outside the law, no
trial is considered necessary. In the evening of July 28, Robespierre and his supporters, including his brother, Saint-Just, Couthon and Hanriot, 22 in all, are guillotined.

- July 29: Arrest and execution of seventy allies of Robespierre within the Paris Commune. In all, 106 Robespierristes are guillotined.
- August 5: Inmates of Paris prisons arrested under the Law of Suspects are released.
- August 9: Napoléon Bonaparte is arrested in Nice, but released on August 20.
- August 24: The Convention reorganizes the government, distributing power among sixteen different committees.
- August 29: First anti-Jacobin demonstration in Paris by disaffected young middle-class Parisians called Muscadins.
- August 30: French army retakes Condé-sur-l'Escaut. All French territory is now freed of foreign occupation.
- August 31: The Convention puts Paris under the direct control of the national government.
- September 1: The Musée des monuments français is founded to protect religious architecture and art threatened with destruction.
- September 13: The Abbé Grégoire, a member of the Convention, coins the term "vandalism" to describe destruction of religious monuments across France.
- September 18: The Convention stops paying officially sanctioned priests and stops maintaining church properties.
- September 21: The remains of Marat are placed in the Panthéon.
- October 1: Confrontations in the meetings of the Paris sections between supporters and opponents of the Terror.
- October 3: Arrest of the leaders of the bands of armed sans-culottes in Paris.
- October 6: A French army captures Cologne.
- October 22: Foundation of the Central School of Public Works, the future École Polytechnique.
- November 9: Muscadins attack the Jacobin Club. The attack is repeated on November 11.
- November 12: The Convention orders the suspension of meetings of the Jacobin Club.
- December 3: The Convention forms a committee of sixteen members to complete work on the Constitution of 1793.
- December 8: Seventy-three surviving Girondin deputies are given seats again in the Convention.
December 16: Conviction and execution of the Jacobin Carrier for ordering the mass execution of as many as 10,000 prisoners in the Vendée

December 24: The Convention repeals the law setting maximum prices for grain and other food products.

1795 – The Directory Replaces the Convention

- January 19: French army of Pichegru captures Amsterdam.
- January 21: French cavalry capture the Dutch fleet, trapped in the ice at Den Helder.
- February 2: Confrontations between Muscadins and sans-culottes in Paris streets.
- February 5: The semi-official government newspaper Le Moniteur Universel condemns the past incitement to violence and terror by Marat and his allies.
- February 8: Removal of the remains of Marat and three other extreme Jacobins from the Panthéon.
- February 14; Several former Jacobin leaders in Lyon, who conducted the Terror there, are assassinated, beginning of the so-called First White Terror.
- February 17: An amnesty granted to former Vendéen rebels, restoring freedom of religion.
- February 21: On a proposal by Boissy d'Anglas, the Convention proclaims freedom of religion and the separation of church and state.
- February 22: In the Convention, the deputy Rovère demands the punishment of Jacobins who carried out the Terror. Former Jacobin leaders in several cities placed under arrest. Four Jacobins in Nîmes who conducted the Terror there are assassinated.
- March 2: The Convention orders the arrest of Barère, Villaud-Varenne, Collot d'Herbois and Vadier, the Jacobins who had orchestrated the downfall of Robespierre.
- March 5: In Toulon, arrest of the Jacobins who had carried out mass executions of the population.
- March 8: Riot in Toulon by sans-culottes, who execute seven imprisoned émigrés.
- March 17: Food riots in Paris.
- March 19: Grain supplies in Paris are exhausted. The assignat falls to eight percent of its original value.
- March 21: On a proposal by Sieyès, the Convention votes the death penalty for leaders of movements who try to overthrow the government.
- March 28: Beginning of the trial of Fouquier-Tinville, the head of the Revolutionary Tribunal, who conducted the trials during the Terror.
- April 1: Insurrection of 12 Germinal, Year III. Sans-culottes invade Convention, but leave when the National Guard arrives. Paris is declared in a state of siege.
April 1: The Convention orders the deportation to French Guiana of Barère, Billaud-Varenne, and Collot d'Herbois, and the arrest of eight extreme-left deputies.

April 2: The French army under Pichegru suppresses an armed uprising in the Faubourg Saint-Antoine.

April 5: Signature of a peace agreement between Prussia and France in Basel. Prussia accepts the French annexation of the left bank of the Rhine.

April 10: Convention orders the disarmament of Jacobins who were involved in the Terror.

April 11: The Convention restores civic rights to all citizens declared outside the law since May 31, 1793.

April 19: Assassination of six Jacobins involved in the Terror in Bourg-en-Bresse.

April 23: The Convention names a commission of eight members to revise the Constitution.

May 2: Agreement of last Vendéen rebels to lay down their arms in exchange for amnesty.

May 4: Massacre of twenty-five Jacobins imprisoned in Lyon.

May 7: The former chief prosecutor, Fouquier-Tinville, and the fourteen jurors of the Revolutionary Tribunal are condemned to death and guillotined.

May 20–24 – Last Paris uprising by the Jacobins and sans-culottes

- May 20: Armed uprising against the Convention by Jacobins and sans-culottes. They invade the hall of the Convention and kill deputy Féraud. The army responds quickly and clears out the hall. The Convention votes the arrest of the Deputies involved in the uprising.

- May 21: New uprising of Jacobins and sans-culottes in Paris; they occupy the Hôtel de Ville.

- May 22: Third day of uprising in Paris. The Convention orders the army to occupy the Faubourg Saint-Antoine.

- May 24: The army secures the Faubourg Saint-Antoine, and disarms and arrests the participants in the uprising.

- May 28: The last Jacobin former members of the Committees of Public Safety and General Security are arrested.

- May 31: The Convention abolishes the Revolutionary Tribunal.

- June 8: Death of the 10-year-old Louis XVII imprisoned in the Temple. His uncle in exile, the comte de Provence, inherits the title as Louis XVIII, king of France.

- June 10: The Convention decriminalizes the émigrés who fled France after the Jacobin seizure of power on May 26, 1793.

- June 12: Deputies who supported the May 20–22 uprising are put on trial.

- June 17: Suicide of six deputies condemned to death for participation in the May 20–22 uprising.
June 25-July 27 – Renewed uprisings in the Vendée and a royalist invasion of Brittany

- June 23: The rebels of the Vendée, under Charette, resume their rebellion.
- June 23: In support of the Chouans, an army of émigrés, under the command of Joseph de Puisaye, landed at Quiberon.
- June 26: An army of four thousand royalist émigrés is landed by the British in the Bay of Carnac in Brittany.
- June 30: The royalist army of émigrés in Brittany is defeated in front of Vannes by General Hoche.
- June 30: The Chouans are forced to abandon Auray. The royalist army retreats to the peninsula of Quiberon, where on July 7 they are besieged by Hoche.
- July 15: Two thousand more royalist émigrés are landed at Quiberon, where they also are trapped by Hoche.
- July 17: The French Army of the Western Pyrenees in Spain under Moncey captures Vitoria-Gasteiz and takes Bilbao on July 19.
- July 21: The royalist army in Quiberon surrenders. 748 émigrés are executed by firing squad.
- July 22: The Peace of Basel is signed between Spain and France. France receives from Spain the western portion of the island of Saint-Dominigue (now the Dominican Republic). With Spain out of the war, France is at war only with Austria and England.
- August 9: The Convention orders the arrest of Joseph Fouché and several other Montagnard deputies.
- August 15: The Convention adopts the Franc as the French monetary unit.

August 22-September 23 – The new Constitution is approved: the Directory takes power

- August 22: Constitution of the Year III (Constitution de l’An III), the new Constitution, is adopted by the Convention. It calls for an upper and lower house of the parliament, on the American and British models, and an executive Directory of five members. According to the terms of the Constitution, two-thirds of the deputies of the new Assembly are former deputies of the Convention.
- September 23: Approved by a national referendum, the new Constitution comes into effect.

October 5 – "A whiff of grapeshot": General Bonaparte suppresses a royalist rebellion in Paris

- October 5: An armed royalist uprising threatens the Convention. On the orders of Paul Barras, in charge of the defense of Paris, General Bonaparte leads the army against the uprising. He uses cannons with grapeshot to break up a rebel gathering in front of the church of Saint-Roch, rue Saint-Honoré.
October 12: Beginning of elections to the new chambers of the legislature, the Council of Five Hundred and the Council of Ancients.

October 12: Montagnard army officers dismissed under the Convention are reintegrated into the army.

October 23: The assignat falls to just three percent of its nominal value. Twenty billion (20,000,000,000) notes in circulation.

October 26: Bonaparte is named commander in chief of the Army of the Interior.

October 31: The first Directory is elected by the legislature; its members are Louis Marie de La Révellière-Lépeaux, Jean-François Rewbell, Étienne-François Letourneur, Paul Barras and Emmanuel Joseph Sieyès, who declines to serve and is replaced by Lazare Carnot.

December 10: The legislature votes a forced loan of six hundred million francs to be taken from the wealthiest French citizens.

December 26: The daughter of Louis XVI and Marie-Antoinette, Madame Royale, imprisoned in the Temple since August 1792, is exchanged for a group of republican prisoners held in Austria.

December 31: Armistice on the Rhine halting combat between the French and Austrian armies.

1796 – Napoleon's campaign in Italy; Defeat of the royalists in the Vendée; a failed uprising in Paris

January 2: Creation by the Directory of the Ministry of the Police, under Merlin de Douai.

January 21: Commemoration of the anniversary of Louis XVI's execution. Director Rewbell gives a speech denouncing the extremism of the left.

January 25: The Directory is given the provisional power to name the administrators of cities.

January 26: The royalist and rebel leader Nicolas Stofflet tries to restart the War in the Vendée.

February 2: Wolfe Tone, leader of the Irish revolutionaries, arrives in France, seeking military support to liberate Ireland.

February 19: The government stops issuing assignats, which have lost most of their value. Thirty-nine billion (39,000,000,000) are in circulation.

February 20: The United States and Britain extend their treaty of November 19, 1794. Relations between France and the United States deteriorate.

February 23: The Vendéen rebel and royalist leader Nicolas Stofflet is captured and executed by firing squad in Angers the following day.


March 2: The Directory names General Bonaparte the commander of the Army of Italy.
March 9: Marriage of Napoléon Bonaparte and Joséphine de Beauharnais, the widow of Alexandre de Beauharnais, a French general and political leader guillotined during the Reign of Terror.

March 18: The Directory replaces the assignat with two billion four hundred million Mandats territoriaux, which can be used to purchase nationalized property. Within three weeks they lose eighty percent of their value.

March 23: François de Charette, last leader of the royalist rebellion in Vendée, is captured and executed by firing squad in Nantes.

March 30: François-Noël Babeuf, known as "Gracchus Babeuf", the ultra-leftist leader and precursor of Communism, forms an insurrectional committee and movement, called Les Égaux ("the Equals"), to overthrow the government. They hold a demonstration in Paris on April 6.

April 10: Bonaparte begins his Italian campaign with victories over the Austrians at Montenotte (April 12) and the Sardinians at Millesimo (April 13).

May 2: Babeuf's followers and the remaining Montagnards form a common plan to overthrow the Directory.

May 9: Bonaparte forces an armistice upon the Duke of Parma.

May 10: Bonaparte defeats the Austrians at the Battle of Lodi.

May 15: Treaty signed in Paris between the Directory and king Victor Amadeus III of Sardinia. The king agrees to cede Savoy and Nice to France.

May 19: In Milan, Bonaparte promises "independence" for Italy.

May 20: The Austrians renounce the armistice along the Rhine, and the war resumes on that front.

June 4: Bonaparte begins the siege of Mantua, the last Italian city held by Austria.

June 5: Bonaparte signs an armistice with the king of Sicily.

June 12: Bonaparte's army enters Romagna, one of the Papal States.

June 22: End of the civil war in the west of France, with the submission of Georges Cadoudal and the departure of Louis de Frotté for England.

June 23: Bonaparte signs the Armistice of Bologna with the Holy See, which permits the French occupation of the northern Papal States.

July 9: The Island of Elba is occupied by the British.

July 10: A new Austrian army under Wurmser arrives in Italy.

July 16: General Kléber captures Frankfurt.

July 18: French army under General Laurent de Gouvion Saint-Cyr captures Stuttgart.

July 20: General Hoche is named head of an army to invade Ireland in support of the Irish independence movement.
• August 5: Bonaparte defeats the Austrians under Wurmser at the Battle of Castiglione. The Austrian army retreats to the Tyrol.

• August 19: Treaty of alliance signed between France and Spain at San Ildefonso.

• September 8: Bonaparte defeats the Austrians under Wurmser at the Battle of Bassano.

• September 9: Failed insurrection at the Grenelle army camp Paris by followers of Gracchus Babeuf, and diehard Montagnards, infiltrated by agents of the police.

• October 5: Spain, now allied with France, declares war on Britain.

• October 10: The thirty-two leaders of the September 9–10 Babeuf uprising are tried by a military tribunal and sentenced to death.

• October 16: Bonaparte encourages the proclamation of a Cispadane Republic in northern Italy, composed of Modena and some of the Papal states.

• November 2: Austria sends two more armies to northern Italy to confront Bonaparte.

• November 15–17: Decisive victory of Bonaparte over the Austrians at the Battle of Arcole.

• December 4: Abrogation of the harshest parts of the October 25, 1795 laws punishing émigrés and refractory priests.

• December 15–17: Departure from Brest of a fleet carrying a French army commanded by Hoche to invade Ireland.

• December 24–25: Storms dislocate the French invasion fleet off the coast of Ireland and force it to return to France.

1797 – Bonaparte chases the Austrians from Italy; a republican coup d'état against the royalists in Paris

• January 7: A new Austrian army commanded by General József Alvinczi is sent to fight General Bonaparte in Italy.

• January 14: Bonaparte defeats the Austrians at the Battle of Rivoli.

• February 2: Surrender of last Austrian forces in Italy, in Mantua, to Bonaparte.

• February 9: Bonaparte occupies Ancona to force Pope Pius VI to negotiate with him. Negotiations begin February 12.

• February 14: Defeat of the Spanish fleet, ally of the French, at the Battle of Cape Saint Vincent.

• February 19: Pius VI cedes Comtat Venaissin and the northern portion of the Italian papal states to the new Cispadane Republic.

• February 20: Beginning of the trial of Babeuf and his leading followers at the High Court of Justice in Vendôme.

March 9: Bonaparte begins a new offensive in Italy against the army of the Archduke Charles, Duke of Teschen.

March 18: French voters are required to take an oath of fidelity to the government before voting on April 18.

April 7: After a series of victories by Bonaparte, the Austrians agree to negotiate.

April 18: Preliminary Treaty of Leoben; Austria gives up its claim to the Austrian Netherlands ("Belgian Provinces"); a secret agreement divides the territories of Venice between Austria and France.

April 18: Results of partial elections for the legislature. 205 of the 216 deputies running are defeated, and many are replaced by royalists.

April 27: Massacre of anti-French insurgents in Verona by French army.

April 30: The Directory ratifies the Treaty of Leoben.

May 2: Bonaparte declares war on Venice.

May 12: Revolutionaries overthrow the government council (Patriciate) of Venice.

May 16: Bonaparte begins negotiations with the Doge of Venice, Ludovico Manin.

May 20: New session of the French legislature begins. The royalist Pichegru is chosen president of the Council of Five Hundred, and another royalist, François Barbé-Marbois becomes president of the Council of Ancients.

May 20: A drawing of lots removes the moderate republican Étienne-François Letourneur. He is replaced by the royalist diplomat François Barthélémy on June 6.

May 26: The political agitator Babeuf and one supporter, Darthé, are sentenced to death. They are executed in Vendôme on May 27.

June 4: First meeting of the Cercle Constitutionnel, a club of prominent moderate republican deputies. Its leaders include Sieyès, Talleyrand, and Garat.

June 14: Bonaparte installs a new government in Genoa, with the aim of creating a new Ligurian Republic.

June 24: The Director Paul Barras contacts General Hoche, seeking support for a coup d'état against the royalist majority in the two Councils.

June 27: The royalist majority in the Councils repeals the law of October 25, 1795, which added punishments against refractory priests and émigrés.

June 28: French troops land on Corfu, previously owned by Venice.

June 28: General Hoche sends 15,000 soldiers from the Rhine to Brest via Paris, on the pretext of planning an invasion of Ireland.
• July 3: Talleyrand proposes a French expedition against Egypt.
• July 9: The French support the formation of the Cisalpine Republic, composed of the former Cispadane Republic and Lombardy.
• July 16: Conflict within the Directory between Barthélemy and Carnot, favorable to the monarchists, and the three pro-republican directors, Barras, La Révellière-Lépeaux, and Rewbell.
• July 17: The army of Hoche arrives within three leagues of Paris, a violation of the Constitution. The royalist Councils protest.
• July 20: Barras produces evidence that General Pichegru was in secret correspondence with Louis XVIII and the monarchists. Carnot joins sides with the three republican directors.
• July 25: The Councils vote a law forbidding political clubs, including the republican Cercle Constitutionnel.
• July 27: Bonaparte sends General Augereau to Paris as military commander of the city, to support a coup d'état against the royalists.
• August 16: Bonaparte writes to the Directory, proposing a military intervention in Egypt "to truly destroy England".

September 4 – A republican coup d'état against the royalists

• September 4: Coup d'état of 18 Fructidor against the royalists in the legislature. Augereau arrests Barthélemy, Pichegru, and the leading royalist deputies.
• September 5: The Directory forces the Councils to adopt new laws annulling the elections of 200 royalist deputies in 53 departments, and deporting 65 royalist leaders and journalists.
• September 8: Election of two new republican directors, Merlin de Douai and François de Neufchâteau, to replace Carnot and Barthélemy.
• September 23: General Augereau, who carried out the September 4 coup, is named commander of the new Army of the Rhine.
• September 29: Directory instructs Bonaparte to win major concessions in negotiations with Austria, and, in the event of refusal, to march on Vienna.
• October 17: Signature of peace between Austria and France in the Treaty of Campo Formio. Austria obtains Venice and its possessions, while France receives Belgium and the right bank of the Rhine River as far as Cologne.
• December 21: Bonaparte meets with the Irish leader Wolfe Tone to discuss a future French landing in Ireland.
• December 28: Anti-French riots in Rome, and murder of a French general, Mathurin-Léonard Duphot.
December 29: Pope Pius VI apologizes to France for the Rome riots; apologies are rejected by the Directory.

1798 – New republics in Switzerland and Italy; an election annulled; Bonaparte invades Egypt

- January 11: The Directory orders General Berthier and his army to march on Rome to punish the papal government for the murder of General Duphot.
- January 18: The legislature authorizes French ships to seize neutral ships carrying British merchandise.
- January 24: The Vaud region of Switzerland, with French support, declares independence from the Swiss government in Bern.
- January 26: The Directory authorizes French troops to intervene on behalf of the Swiss uprising in Vaud against the Swiss government.
- February 10: Berthier and his army enter Rome.
- February 14: Talleyrand presents to the Directory a project for a French conquest of Egypt.
- February 15: General Berthier, in Rome, proclaims a new Roman Republic, under French protection.
- March 5: The Directory approves Bonaparte's plan to invade Egypt.
- March 6: The French army captures Bern.
- March 9: The Parliament of German states, meeting in Rastadt, accepts the annexation of the left bank of the Rhine by France.
- March 22: Under the sponsorship of General Brune, an assembly in Aarau proclaims a Helvetic Republic.
- April 4: Following the French model, the new Helvetic Republic declares itself a secular republic.
- April 9–18: Elections for one-third of the seats in the French legislature.
- April 26: The Traité de Réunion formally unites the Republic of Geneva (fr) with the French Republic.
- May 7: A report to the Council of Five Hundred declares that the French elections were irregular, and recommends exclusion of candidates of the far left.
- May 11: By the Law of 22 Floréal Year VI, the Council of Ancients and the Council of Five Hundred invalidate the election of 106 Jacobin deputies.
- May 15: Jean Baptiste Treilhard is elected to the Directory in place of François de Neufchâteau.
• May 19: Bonaparte and his Armée d'Orient set sail from Toulon for Egypt.
• May 23: Anti-British uprising begins in Ireland; the Irish rebels believe that Bonaparte is sailing to Ireland.
• June 9–11: Bonaparte invades and captures Malta.
• July 1–2: Bonaparte lands in Egypt and captures Alexandria.
• July 14: Irish uprising suppressed by the British army.
• July 21: Bonaparte defeats the Mameluks at the Battle of the Pyramids.
• July 24: Bonaparte and his army enter Cairo.
• August 1: Admiral Nelson and the British fleet destroy the French fleet at the Battle of the Nile, stranding Bonaparte in Egypt.
• August 6: A French fleet and expeditionary force sails for Ireland to aid the Irish rebels, though the rebellion is already defeated.
• August 22: French troops under General Humbert land at Killala, in northwest Ireland.
• August 27: General Humbert defeats a British force at the Battle of Castlebar, and declares an Irish republic.
• September 2: Suppression of a royalist revolt in the south of the Massif Central in France and the arrest of its leaders.
• September 5: The French legislature requires all French men between twenty and twenty-five to perform military service.
• September 9: The forces of General Humbert are surrounded by the British army at the Battle of Ballinamuck and forced to surrender.
• September 16: A new French expeditionary force sails from Brest to Ireland.
• September 24: The French government calls 200,000 men for military service.
• October 8: François de Neufchâteau, Minister of the Interior, creates the first Higher Council on Public Education.
• October 11: French fleet and expeditionary force defeated off coast of Ireland; six of eight warships captured.
• October 12: Belgian peasants rebel against obligatory service in French army.
• October 21: Population of Cairo rebels against French occupation. Rebellion suppressed by Bonaparte on October 22.
• November 4: Directory orders deportation of Belgian priests, blamed for peasant uprising.
• November 5: A Russian-Turkish fleet blockades Corfu occupied by the French army.
• November 16: Austria and England agree to cooperate to force France back to its 1789 boundaries.
• November 23–24: Directory, desperate for money, imposes new real estate tax and additional taxes based on number of doors and windows.

• November 27: The army of the King of Naples captures Rome.

• December 4: French troops defeat Belgian rebels at Hasselt and massacre insurgents. End of peasant uprising in Belgium.

• December 6: French army under Jean Étienne Championnet defeats the army of the King of Naples at Battle of Civita Castellana.

• December 14: French army under Championnet recaptures Rome.

• December 21: French army attacks Naples and forces King of Naples to take sanctuary on the flagship of Admiral Nelson.

• December 29: Alliance (Second Coalition) between Russia, Britain and the Kingdoms of Naples and Sicily against France signed.

1799 – France at War in Italy and Germany; Bonaparte returns from Egypt; the Consulate seizes power; End of the Revolution

• January 10: The army of General Championnet captures Capua.

• January 23: French army occupies Naples

• January 26: Proclamation of a new republic in Naples, named Parthénopéenne by the Directory

• February 1: Victory of General Louis Desaix over the Mameluks at Aswan completes the French conquest of upper Egypt.

• February 3: Conflict between Generals Championnet and Faipoult over the command of French troops in Naples.

• February 6: Championnet orders the expulsion of Faipoult from Naples.

• February 20: Bonaparte marches his army from Cairo toward Syria.

• February 20: Bonaparte defeats a Turkish army and occupies Arish in the Sinai Peninsula.

• February 24: The Directory orders the arrest of General Championnet.

• February 24: General Jean-Baptiste Jourdan assembles the Army of the Danube and prepares to cross the Rhine and invade German states and Austria.

• March 1–2: French armies under Jourdan and Bernadotte cross the Rhine.

• March 3: French troops in Corfu surrender, after a long siege by a Russian-Turkish fleet.

• March 7: Bonaparte captures Jaffa in Palestine. Some of his soldiers are infected with the plague.

• March 11: Bonaparte visits the hospital for plague victims in Jaffa.
March 12: The Directory declares war on Austria and on the Grand Duchy of Tuscany.

March 19: Bonaparte lays siege to Saint-Jean-d'Acre in Palestine.

March 21: French troops enter the Grand Duchy of Tuscany.

March 23: Army of General Massena defeated by Austrians at Battle of Feldkirch.

March 25: Defeat of Jourdan by Austrians at Battle of Stockach.

March 28: Bonaparte tries unsuccessfully to capture Saint-Jean-d'Acre.

April 1: Bonaparte fails again to take Saint-Jean-d'Acre.

April 3: Jourdan resigns as commander of the Army of the Danube. His army pulls back to the west bank of the Rhine on April 6.

April 9: Beginning of legislative elections in France to replace one-third of members.

April 10: Pope Pius VI, a prisoner of the French, is transferred to France.

April 14: The Austrian army of Melas and the Russian army of Alexander Suvorov join in Italy.

April 16: Bonaparte defeats the Ottoman army led by Abdullah Pasha al-Azm at the Battle of Mount Tabor.

April 18: French elections result in a major loss for supporters of the government, and a victory for the extreme left.

April 24: Bonaparte fails a third time to capture Saint-Jean-d'Acre.

April 27: Alexander Suvorov's Russo-Austrian army defeats French forces under General Moreau at the Battle of Cassano.

April 29: Suvorov enters Milan.

May 1: Bonaparte fails for a fourth time to capture Saint-Jean-d'Acre.

May 10: Fifth and last attempt by Bonaparte to capture Saint-Jean-d'Acre. He lifts the siege on May 17.

May 16: As the result of the system of drawing lots, Rewbell leaves the Directory and is replaced by Sieyès, who is seen as a moderate leftist.

May 19: An English fleet lands soldiers at Ostend in Belgium. The expedition fails, and withdraws the following day.

May 26: Russo-Austrian army enters Turin.

June 4–6: Masséna is forced to withdraw his forces from Zürich.

June 14: Bonaparte returns to Cairo.
Conflicts between the Directory and the Legislature (June 1799)

- June 16: A serious struggle begins between the newly elected left-wing members of the Council of Five Hundred and the Directory, due to the string of French military defeats. The legislature demands new measures for "public safety".
- June 17: The Council of Five Hundred and Council of the Ancients annul the election of Jean Baptiste Treilhard to the Directory and replace him with a leftist member, Louis-Jérôme Gohier.
- June 18–19: Two royalist members of the Directory, Philippe-Antoine Merlin de Douai and La Révellière-Lépeaux, are forced to resign, under threat of being brought to trial by the Councils. They are replaced by two moderate leftists, Roger Ducos, and Jean-François-Auguste Moulin. (Coup of 30 Prairial Year VII)
- June 19: A French army under Étienne Macdonald is defeated by the Russians under Suvorov at the Battle of the Trebia.
- June 19: Another reversal in Italy: the French garrison of Naples surrenders.
- June 28: The Council votes to demand a forced loan of one hundred million francs from wealthy citizens to equip new armies.
- July 5: Two commanders with neo-Jacobin sympathies are promoted by the Directory: Joubert is named new commander of the Army of Italy, and Championnet is chosen to command the Army of the Alps.
- July 7: A neo-Jacobin club, the Société des amis de la Liberté et de l'Égalité ("Society of the Friends of Liberty and Equality"), is founded in Paris.
- July 12: The Council of Five Hundred votes a new law on hostages, demands lists of royalists be made in each department, and brings accusations against former members of the Directory with royalist tendencies.
- July 14: At a celebration of the anniversary of the Revolution, General Jourdan calls "bringing back the pikes", the weapons of the Jacobin street mobs during the Terror. On the same day, Siéyès gives a speech denouncing the new Jacobins.
- July 17: An Ottoman army under the command of Seid Mustafa Pasha, transported to Egypt by Sidney Smith's British fleet, lands at Abukir.
- July 25: Bonaparte defeats Seid Mustafa Pasha's Ottoman army at the Battle of Abukir.
- August 6: Royalist uprisings in Toulouse and Bordeaux. Both are quickly suppressed by the army.
- August 15: Defeat of the French Army of Italy under General Joubert at the Battle of Novi. Joubert is killed.
- August 18: The Council of Five Hundred decides, by a vote of 217–214, not to arrest and try the former members of the Directory accused of royalist sympathies.
August 23: Bonaparte has had no news from France in six months. The British admiral Sir Sidney Smith sends him a packet of French newspapers, which he reads in one night. He hands over command of the army to General Kléber and leaves Egypt with a small party aboard the frigate *La Muiron*.

August 29: Pope Pius VI dies, a French prisoner, in Valence.

August 29: Championnet, prominent among the Jacobin generals, is named new commander of the Army of Italy.

September 13: General Jourdan, leader of the Jacobins in the army, asks the Council of Five Hundred to declare a state of national emergency.

September 14: Council of Five Hundred refuses to declare a state of national emergency.

September 14: The Director Sieyès obtains the resignation of Jean Bernadotte as Minister of War, on the grounds that Bernadotte was planning a Jacobin coup d'état.

September 15: The royalist leaders in the west of France, including the Breton Chouan leader Georges Cadoudal, meet to organize a new uprising against Paris.

September 24: The royalist military commander Louis de Frotté lands in Normandy to take charge of the new uprising.


September 29: The Russian army under Suvorov is forced to retreat across the Alps.

October 6: A French-Dutch army under General Brune defeats a Russian-British force at the Battle of Castricum. The British and Russians withdraw their troops from the Netherlands.

**Bonaparte returns to France (October 9, 1799)**

October 9: Bonaparte lands at Saint-Raphaël.

October 14: Sieyès invites General Moreau to organize a coup d'état against the Jacobins in the Councils, but Moreau refuses.

October 16: Bonaparte arrives in Paris to public celebrations.

October 17: Bonaparte is received by the Directory.

October 19: The royalist forces in the west, the Chouans, capture Nantes, but are forced to withdraw the next day.

October 23: The Russian Czar Paul I orders the withdrawal of Russian troops from the war against the French.
October 23: Lucien Bonaparte, younger brother of General Napoléon Bonaparte, is elected President of the Council of Five Hundred.

October 23–29: Royalist forces in Brittany and the Vendée briefly capture several cities, but are quickly driven out by the French army.

November 1: Bonaparte meets with Sieyès; the two men dislike each other, but agree to a parliamentary coup d'état to replace the Directory.

November 3: Bonaparte meets with Fouché, the Minister of Police, who agrees not to interfere with a coup d'état.

November 6: The Councils of the Ancients and the Five Hundred offer a banquet to Bonaparte at the former church of Saint Sulpice.

November 7: General Jourdan proposes that Bonaparte join him in a Jacobin coup d'état against the Directory. Bonaparte refuses.

November 8: Bonaparte dines with Cambacérès and arranges the final details of the coup d'état.

The Coup d'État of November 9–10

November 9: The coup d'état of 18 Brumaire begins. French troops loyal to Bonaparte occupy key points in Paris. Lucien Bonaparte, the president of the Council of Five Hundred, warns the deputies that a "terrorist" plot against the legislature has been discovered, and asks that the meetings of the Councils, scheduled for the next day, be moved for their security to the château of Saint-Cloud, some 10 kilometers west of Paris. Bonaparte is named Commander-in-chief of the army in Paris.

As agreed in advance, two members of the Directory who are complicit in the coup, Sieyès and Ducos, offer their resignation. A third, Barras, is talked into resigning by Talleyrand. The two Jacobin directors, Gohier and Moulin, are arrested by the soldiers of General Moreau and confined at the Luxembourg Palace. Fouché proposes to arrest the leading Jacobin members of the Council of Five Hundred, but Bonaparte does not feel it is necessary, which proves to be a mistake. By the end of the day, Paris is entirely under the control of Bonaparte and officers loyal to him.

November 10: As proposed by Bonaparte, the members of the two Councils are transported to the château of Saint-Cloud. 6,000 soldiers have been assembled by Bonaparte there, soldiers who are largely hostile to the Councils because of delays in their pay.

Bonaparte speaks first to the Council of the Ancients, explaining the need for a change in government. The upper Council listens in silence and votes without opposition to accept Bonaparte's proposal. Bonaparte then addresses the Council of Five Hundred, meeting in the orangerie of the domain of Saint-Cloud. Here his reception is much different: the Jacobin members protest angrily, insult and shout down Bonaparte, threatening to declare him outside the law, which would have led to his immediate arrest. While the
Council debated in great confusion inside, Lucien Bonaparte takes Bonaparte outside, and tells the waiting soldiers that the deputies had tried to assassinate Bonaparte. The soldiers, furious, invade the meeting hall and chase out the deputies at the point of bayonets. In the absence of the opposition deputies, two parliamentary commissions name Bonaparte, Sieyès and Duclos as the provisional consuls of a new government.

- November 11–22: Bonaparte and the two other Provisional Consuls form a new government, Berthier as minister of War, Talleyrand in charge of foreign relations, Fouché as minister of Police, and Cambacérès as minister of Justice.
- December 1: Bonaparte rejects a constitution proposed by Sieyès.
- December 24: The Councils, now firmly under the control of Bonaparte, adopt the Constitution of the Year VIII. The new Consulate is formally established, with Bonaparte as First Consul, Cambacérès as Second Consul, and Charles-François Lebrun as Third Consul. Traditional histories mark this date as the end of the French Revolution.

"History is always written by the winners. When two cultures clash, the loser is obliterated, and the winner writes the history books-books which glorify their own cause and disparage the conquered foe. As Napoleon once said, 'What is history, but a fable agreed upon?"

— Dan Brown, The Da Vinci Code
### Timeline of chemical element discoveries

#### Ancient discoveries

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<td>29</td>
<td>Copper</td>
<td>9000 BC</td>
<td>6000 BC</td>
<td>Middle East</td>
<td>Anatolia</td>
<td>Copper was probably the first metal mined and crafted by humans. It was originally obtained as a native metal and later from the smelting of ores. Earliest estimates of the discovery of copper suggest around 9000 BC in the Middle East. It was one of the most important materials to humans throughout the Chalcolithic and Bronze Ages. Copper beads dating from 6000 BC have been found in Çatal Höyük, Anatolia and the archaeological site of Belovode on the Rudnik mountain in Serbia contains the world's oldest securely dated evidence of copper smelting from 5000 BC.</td>
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<td>Lead</td>
<td>7000 BC</td>
<td>3800 BC</td>
<td>Africa</td>
<td>Abydos, Egypt</td>
<td>It is believed that lead smelting began at least 9,000 years ago, and the oldest known artifact of lead is a statuette found at the temple of Osiris on the site of Abydos dated around 3800 BC.</td>
</tr>
<tr>
<td>79</td>
<td>Gold</td>
<td>Before 6000 BC</td>
<td>Before 4000 BC</td>
<td>Levant</td>
<td>Wadi Qana</td>
<td>The earliest gold artifacts were discovered at the site of Wadi Qana in the Levant.</td>
</tr>
<tr>
<td></td>
<td>Metal</td>
<td>Time</td>
<td>Region</td>
<td>Find Site</td>
<td>Notes</td>
<td></td>
</tr>
<tr>
<td>---</td>
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<td>-------------------------------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>47</td>
<td>Silver</td>
<td>Before 5000 BC to ca. 4000 BC</td>
<td>Asia Minor</td>
<td>Asia Minor</td>
<td>Estimated to have been discovered in Asia Minor shortly after copper and gold.</td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>Iron</td>
<td>Before 5000 BC to 4000 BC</td>
<td>Middle East</td>
<td>Egypt</td>
<td>There is evidence that iron was known from before 5000 BC. The oldest known iron objects used by humans are some beads of meteoric iron, made in Egypt in about 4000 BC. The discovery of smelting around 3000 BC led to the start of the Iron Age around 1200 BC and the prominent use of iron for tools and weapons.</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Carbon</td>
<td>3750 BC to 2500 BC</td>
<td>Egyptians and Sumerians</td>
<td>Middle East</td>
<td>The earliest known use of charcoal was for the reduction of copper, zinc, and tin ores in the manufacture of bronze, by the Egyptians and Sumerians. Diamonds were probably known as early as 2500 BC. True chemical analyses were made in the 18th century, and in 1789 carbon was listed by Antoine Lavoisier as an element.</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>Tin</td>
<td>3500 BC to 2000 BC</td>
<td>Asia Minor</td>
<td>Kestel</td>
<td>First smelted in combination with copper around 3500 BC to produce bronze (and thus giving place to the Bronze Age in those places where Iron Age did not intrude directly on Neolithic of the Stone Age). Kestel, in southern Turkey, is the site of an ancient Cassiterite mine that was used from 3250 to 1800 BC. The oldest artifacts date from around 2000 BC.</td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Sulfur</td>
<td>Before</td>
<td>Middle East</td>
<td>Middle East</td>
<td>First used at least 4,000 years</td>
<td></td>
</tr>
<tr>
<td>Element</td>
<td>Discovery</td>
<td>Period</td>
<td>Origin</td>
<td>Key Figures</td>
<td>Notes</td>
<td></td>
</tr>
<tr>
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<td></td>
</tr>
<tr>
<td>Mercury</td>
<td>2000 BC</td>
<td>1500 BC</td>
<td>Egyptians</td>
<td>Egypt</td>
<td>Found in Egyptian tombs dating from 1500 BC. Recognized as an element by Jabir ibn Hayyan before AD 815, and by Antoine Lavoisier in 1777.</td>
<td></td>
</tr>
<tr>
<td>Zinc</td>
<td>Before 1000 BC</td>
<td>1000 BC</td>
<td>Indian metallurgists</td>
<td>Indian subcontinent</td>
<td>Used as a component of brass since antiquity (before 1000 BC) by Indian metallurgists, but its true nature was not understood in ancient times. Identified as a distinct metal in the <em>Rasaratna Samuccaya</em> around the 14th century of the Christian era and by the alchemist Paracelsus in 1526. Isolated by Andreas Sigismund Marggraf in 1746.</td>
<td></td>
</tr>
<tr>
<td>Arsenic</td>
<td>Before AD 815</td>
<td>Before AD 815</td>
<td>Middle-Eastern alchemists</td>
<td>Middle East</td>
<td>The use of metallic arsenic was described by the Egyptian alchemist Zosimos. The purification of arsenic was later described by Persian alchemist Jabir ibn Hayyan. Albertus Magnus (c. 1200-1280) is typically credited with the description of the metalloid in the West.</td>
<td></td>
</tr>
<tr>
<td>Antimony</td>
<td>Before AD 815</td>
<td>Before AD 815</td>
<td>Jabir ibn Hayyan</td>
<td>Middle East</td>
<td>Dioscorides and Pliny both describe the accidental production of metallic antimony from stibnite, but only seem to recognize the metal as lead. The intentional isolation of antimony is described by Persian alchemist Jabir ibn Hayyan. In Europe, the metal was being</td>
<td></td>
</tr>
</tbody>
</table>
produced and used by 1540, when it was described by Vannoccio Biringuccio.

<table>
<thead>
<tr>
<th>Z</th>
<th>Element</th>
<th>Observed or predicted</th>
<th>Isolated (widely known)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>83</td>
<td>Bismuth</td>
<td>Before AD 1000</td>
<td>Before AD 1000</td>
<td>Middle East</td>
</tr>
<tr>
<td>83</td>
<td>Bismuth</td>
<td>Jabirian corpus</td>
<td></td>
<td>Described by Persian alchemist Jabir ibn Hayyan in the Jabirian corpus. Later described in Europe by Claude François Geoffroy in 1753.</td>
</tr>
</tbody>
</table>

Modern discoveries

<table>
<thead>
<tr>
<th>Z</th>
<th>Element</th>
<th>Observed or predicted</th>
<th>Isolated (widely known)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Phosphorus</td>
<td>1669</td>
<td>H. Brand</td>
<td>1669</td>
</tr>
<tr>
<td>27</td>
<td>Cobalt</td>
<td>1735</td>
<td>G. Brandt</td>
<td>1735</td>
</tr>
<tr>
<td>78</td>
<td>Platinum</td>
<td>1735</td>
<td>A. de Ulloa</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Nickel</td>
<td>1751</td>
<td>F. Cronstedt</td>
<td>1751</td>
</tr>
</tbody>
</table>
copper (now known as niccolite).

<table>
<thead>
<tr>
<th>#</th>
<th>Element</th>
<th>Year</th>
<th>Discoverer</th>
<th>Year</th>
<th>Isolator</th>
</tr>
</thead>
<tbody>
<tr>
<td>12</td>
<td>Magnesium</td>
<td>1755</td>
<td>J. Black</td>
<td>1808</td>
<td>H. Davy</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Hydrogen</td>
<td>1766</td>
<td>H. Cavendish</td>
<td>ca. 1500</td>
<td>Paracelsus</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Oxygen</td>
<td>1771</td>
<td>W. Scheele</td>
<td>1604</td>
<td>Sendivogius</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Nitrogen</td>
<td>1772</td>
<td>D. Rutherford</td>
<td>1772</td>
<td>D. Rutherford</td>
</tr>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Black observed that magnesia alba (MgO) was not quicklime (CaO). Davy isolated the metal electrochemically from magnesia.

Cavendish was the first to distinguish H₂ from other gases, although Paracelsus around 1500, Robert Boyle, and Joseph Priestley had observed its production by reacting strong acids with metals. Lavoisier named it in 1783. It was the first elemental gas known.

Obtained it by heating mercuric oxide and nitrates in 1771, but did not publish his findings until 1777. Joseph Priestley also prepared this new air by 1774, but only Lavoisier recognized it as a true element; he named it in 1777. Before him, Sendivogius had produced oxygen by heating saltpetre, correctly identifying it as the "food of life".

He discovered nitrogen while he was studying at the University of
Edinburgh. He showed that the air in which animals had breathed, even after removal of the exhaled carbon dioxide, was no longer able to burn a candle. Carl Wilhelm Scheele, Henry Cavendish, and Joseph Priestley also studied the element at about the same time, and Lavoisier named it in 1775-6.

<table>
<thead>
<tr>
<th>56</th>
<th>Barium</th>
<th>1772</th>
<th>W. Scheele</th>
<th>1808</th>
<th>H. Davy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Scheele distinguished a new earth (BaO) in pyrolusite and Davy isolated the metal by electrolysis.

<table>
<thead>
<tr>
<th>17</th>
<th>Chlorine</th>
<th>1774</th>
<th>W. Scheele</th>
<th>1774</th>
<th>W. Scheele</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Obtained it from hydrochloric acid, but thought it was an oxide. Only in 1808 did Humphry Davy recognize it as an element.

<table>
<thead>
<tr>
<th>25</th>
<th>Manganese</th>
<th>1774</th>
<th>W. Scheele</th>
<th>1774</th>
<th>G. Gahn</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

Distinguished pyrolusite as the calx of a new metal. Ignatius Gottfred Kaim also discovered the new metal in 1770, as did Scheele in 1774. It was isolated by reduction of manganese dioxide with carbon.

<table>
<thead>
<tr>
<th>42</th>
<th>Molybdenum</th>
<th>1778</th>
<th>W. Scheele</th>
<th>1781</th>
<th>J. Hjelm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

Scheele recognised the metal as a constituent of molybdena.

<table>
<thead>
<tr>
<th>74</th>
<th>Tungsten</th>
<th>1781</th>
<th>W. Scheele</th>
<th>1783</th>
<th>J. and F. Elhuyar</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tbody>
</table>

Scheele obtained from scheelite an oxide of a
new element. The Elhuyars obtained tungstic acid from wolframite and reduced it with charcoal.

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>52</td>
<td>Tellurium</td>
<td>1782</td>
<td>F.-J.M. von Reichenstein</td>
</tr>
<tr>
<td>38</td>
<td>Strontium</td>
<td>1787</td>
<td>W. Cruikshank</td>
</tr>
<tr>
<td>1789</td>
<td>A. Lavoisier</td>
<td>The first modern list of chemical elements – containing 33 elements including light, heat, unextracted &quot;radicals&quot; and some oxides. He also redefined the term &quot;element&quot;. Until then, no metals except mercury were considered elements.</td>
<td></td>
</tr>
<tr>
<td>40</td>
<td>Zirconium</td>
<td>1789</td>
<td>H. Klaproth</td>
</tr>
<tr>
<td>92</td>
<td>Uranium</td>
<td>1789</td>
<td>H. Klaproth</td>
</tr>
<tr>
<td>22</td>
<td>Titanium</td>
<td>1791</td>
<td>W. Gregor</td>
</tr>
</tbody>
</table>
discovered the element in rutile in 1795 and named it. The pure metallic form was only obtained in 1910 by Matthew A. Hunter.

<table>
<thead>
<tr>
<th>Element</th>
<th>Discovery Year</th>
<th>Discoverer</th>
<th>Isolation Year</th>
<th>Isolated By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yttrium</td>
<td>1794</td>
<td>J. Gadolin</td>
<td>1843</td>
<td>H. Rose</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium</td>
<td>1794</td>
<td>N. Vauquelin</td>
<td>1797</td>
<td>N. Vauquelin</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beryllium</td>
<td>1798</td>
<td>N. Vauquelin</td>
<td>1828</td>
<td>F. Wöhler and A. Bussy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vanadium</td>
<td>1801</td>
<td>M. del Rio</td>
<td>1830</td>
<td>N.G.Sefström</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Niobium</td>
<td>1801</td>
<td>C. Hatchett</td>
<td>1864</td>
<td>W. Blomstrand</td>
</tr>
</tbody>
</table>

Discovered in gadolinite, but Mosander showed later that its ore, yttria, contained more elements. Wöhler mistakenly thought he had isolated the metal in 1828 from a volatile chloride he supposed to be yttrium chloride, but Rose proved otherwise in 1843 and correctly isolated the element himself that year.

Vauquelin discovered the trioxide in crocoite ore, and later isolated the metal by heating the oxide in a charcoal oven.

Vauquelin discovered the oxide in beryl and emerald, and Klaproth suggested the present name around 1808.

Río found the metal in vanadinite but retracted the claim after Hippolyte Victor Collet-Descotils disputed it. Sefström isolated and named it, and later it was shown that Río had been right in the first place.

Hatchett found the element in columbite ore and named...
it columbium. Heinrich Rose proved in 1844 that the element is distinct from tantalum, and renamed it niobium which was officially accepted in 1949.

<table>
<thead>
<tr>
<th>73</th>
<th>Tantalum</th>
<th>1802</th>
<th>G. Ekeberg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>46</th>
<th>Palladium</th>
<th>1802</th>
<th>W. H. Wollaston</th>
<th>1802</th>
<th>W. H. Wollaston</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Wollaston discovered it in samples of platinum from South America, but did not publish his results immediately. He had intended to name it after the newly discovered asteroid, Ceres, but by the time he published his results in 1804, cerium had taken that name. Wollaston named it after the more recently discovered asteroid Pallas.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>58</th>
<th>Cerium</th>
<th>1803</th>
<th>H. Klaproth, J. Berzelius, and W. Hisinger</th>
<th>1838</th>
<th>G. Mosander</th>
</tr>
</thead>
</table>
|    |        |      | Berzelius and Hisinger discovered the element in ceria and named it after the newly discovered asteroid (then considered a planet), Ceres. Klaproth discovered it simultaneously and independently in some tantalum samples. Mosander proved later that the samples of all three researchers had at
<table>
<thead>
<tr>
<th>Atomic Number</th>
<th>Element</th>
<th>Year</th>
<th>Discoverer 1</th>
<th>Year</th>
<th>Discoverer 2</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>76</td>
<td>Osmium</td>
<td>1803</td>
<td>S. Tennant</td>
<td>1803</td>
<td>S. Tennant</td>
<td>Tennant had been working on samples of South American platinum in parallel with Wollaston and discovered two new elements, which he named osmium and iridium.</td>
</tr>
<tr>
<td>77</td>
<td>Iridium</td>
<td>1803</td>
<td>S. Tennant</td>
<td>1803</td>
<td>S. Tennant</td>
<td>Tennant had been working on samples of South American platinum in parallel with Wollaston and discovered two new elements, which he named osmium and iridium, and published the iridium results in 1804.</td>
</tr>
<tr>
<td>45</td>
<td>Rhodium</td>
<td>1804</td>
<td>H. Wollaston</td>
<td>1804</td>
<td>H. Wollaston</td>
<td>Wollaston discovered and isolated it from crude platinum samples from South America.</td>
</tr>
<tr>
<td>19</td>
<td>Potassium</td>
<td>1807</td>
<td>H. Davy</td>
<td>1807</td>
<td>H. Davy</td>
<td>Davy discovered it by using electrolysis on potash.</td>
</tr>
<tr>
<td>11</td>
<td>Sodium</td>
<td>1807</td>
<td>H. Davy</td>
<td>1807</td>
<td>H. Davy</td>
<td>Andreas Sigismund Marggraf recognised the difference between soda ash and potash in 1758. Davy discovered sodium a few days after potassium, by using electrolysis on sodium hydroxide.</td>
</tr>
<tr>
<td>20</td>
<td>Calcium</td>
<td>1808</td>
<td>H. Davy</td>
<td>1808</td>
<td>H. Davy</td>
<td>Davy discovered the metal by electrolysis of quicklime.</td>
</tr>
<tr>
<td>5</td>
<td>Boron</td>
<td>1808</td>
<td>L. Gay-Lussac and L.J. Thénard</td>
<td>1808</td>
<td>H. Davy</td>
<td>Radical boracique appears on the list of elements in</td>
</tr>
</tbody>
</table>
Lavoisier's *Traité Élémentaire de Chimie* from 1789. On June 21, 1808, Lussac and Thénard announced a new element in sedative salt, Davy announced the isolation of a new substance from boracic acid on June 30.

<table>
<thead>
<tr>
<th>Period</th>
<th>Element</th>
<th>Year</th>
<th>Discoverer</th>
<th>Year</th>
<th>Isolator</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>Fluorine</td>
<td>1810</td>
<td>A.-M. Ampère</td>
<td>1886</td>
<td>H. Moissan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>53</td>
<td>Iodine</td>
<td>1811</td>
<td>B. Courtois</td>
<td>1811</td>
<td>B. Courtois</td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>3</td>
<td>Lithium</td>
<td>1817</td>
<td>A. Arfwedson</td>
<td>1821</td>
<td>W. T. Brande</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48</td>
<td>Cadmium</td>
<td>1817</td>
<td>S. L Hermann, F. Stromeyer, and J.C.H. Roloff</td>
<td>1817</td>
<td>S. L Hermann, F. Stromeyer, and J.C.H. Roloff</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Selenium</td>
<td>1817</td>
<td>J. Berzelius and G. Gahn</td>
<td>1817</td>
<td>J. Berzelius and G. Gahn</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Atomic Number</td>
<td>Element</td>
<td>Year (Isolated)</td>
<td>Year (Name Proposed)</td>
<td>Discoverer</td>
<td>Comment</td>
</tr>
<tr>
<td>---------------</td>
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<td>---------</td>
</tr>
<tr>
<td>14</td>
<td>Silicon</td>
<td>1823</td>
<td>J. Berzelius</td>
<td>1823</td>
<td>Humphry Davy thought in 1800 that silica was a compound, not an element, and in 1808 suggested the present name. In 1811 Louis-Joseph Gay-Lussac and Louis-Jacques Thénard probably prepared impure silicon, but Berzelius is credited with the discovery for obtaining the pure element in 1823.</td>
</tr>
<tr>
<td>13</td>
<td>Aluminium</td>
<td>1825</td>
<td>H.C.Ørsted</td>
<td>1825</td>
<td>Antoine Lavoisier predicted in 1787 that alumina is the oxide of an undiscovered element, and in 1808 Humphry Davy tried to decompose it. Although he failed, he suggested the present name. Hans Christian Ørsted was the first to isolate metallic aluminium in 1825.</td>
</tr>
<tr>
<td>35</td>
<td>Bromine</td>
<td>1825</td>
<td>J. Balard and C. Löwig</td>
<td>1825</td>
<td>They both discovered the element in the autumn of 1825. Balard published his results the next year, but Löwig did not publish until 1827.</td>
</tr>
<tr>
<td>90</td>
<td>Thorium</td>
<td>1829</td>
<td>J. Berzelius</td>
<td>1829</td>
<td>Berzelius obtained the oxide of a new earth in thorite.</td>
</tr>
<tr>
<td>57</td>
<td>Lanthanum</td>
<td>1838</td>
<td>G. Mosander</td>
<td>1841</td>
<td>Mosander found a new element in samples of ceria</td>
</tr>
</tbody>
</table>
and published his results in 1842, but later he showed that this lanthana contained four more elements.

<table>
<thead>
<tr>
<th>Element</th>
<th>Year Disc</th>
<th>Discoverer 1</th>
<th>Year</th>
<th>Discoverer 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Erbium</td>
<td>1843</td>
<td>G. Mosander</td>
<td>1879</td>
<td>T. Cleve</td>
</tr>
<tr>
<td>Terbium</td>
<td>1843</td>
<td>G. Mosander</td>
<td>1886</td>
<td>J.C.G. de Marignac</td>
</tr>
<tr>
<td>Ruthenium</td>
<td>1844</td>
<td>K. Claus</td>
<td>1844</td>
<td>K. Claus</td>
</tr>
<tr>
<td>Caesium</td>
<td>1860</td>
<td>R. Bunsen and R. Kirchhoff</td>
<td>1882</td>
<td>C. Setterberg</td>
</tr>
<tr>
<td>Rubidium</td>
<td>1861</td>
<td>R. Bunsen and G. R. Kirchhoff</td>
<td>Hevesy</td>
<td></td>
</tr>
</tbody>
</table>

Gottfried Wilhelm Osann thought that he found three new metals in Russian platinum samples, and in 1844 Karl Karlovich Klaus confirmed that there was a new element.

Bunsen and Kirchhoff were the first to suggest finding new elements by spectrum analysis. They discovered caesium by its two blue emission lines in a sample of Dürrheim mineral water. The pure metal was eventually isolated in 1882 by Setterberg.

Bunsen and Kirchhoff discovered it just a few months after caesium, by observing new spectral lines in the mineral lepidolite. Bunsen never obtained a pure sample of the metal,
which was later obtained by Hevesy.

<table>
<thead>
<tr>
<th>Atomic Number</th>
<th>Element</th>
<th>Year</th>
<th>Discoverer(s)</th>
<th>Year</th>
<th>Second Discoverer(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>81</td>
<td>Thallium</td>
<td>1861</td>
<td>W. Crookes</td>
<td>1862</td>
<td>C.-A. Lamy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>49</td>
<td>Indium</td>
<td>1863</td>
<td>F. Reich and T. Richter</td>
<td>1867</td>
<td>T. Richter</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>2</td>
<td>Helium</td>
<td>1868</td>
<td>P. Janssen and N. Lockyer</td>
<td>1895</td>
<td>W. Ramsay, T. Cleve, and N. Langlet</td>
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<tr>
<td></td>
<td></td>
<td>1869</td>
<td>D. I. Mendeleev</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Mendeleev arranges the 64 elements known at that time into the first modern periodic table and correctly predicts several others.</td>
</tr>
<tr>
<td>31</td>
<td>Gallium</td>
<td>1875</td>
<td>P. E. L. de Boisbaudran</td>
<td></td>
<td>P. E. L. de Boisbaudran</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Boisbaudran observed on a pyrene blende sample some emission lines corresponding to the eka-aluminium that was predicted by Mendeleev</td>
</tr>
</tbody>
</table>
in 1871 and subsequently isolated the element by electrolysis.

<table>
<thead>
<tr>
<th>Element</th>
<th>Year</th>
<th>Discoverer</th>
<th>Year</th>
<th>Discoverer</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ytterbium</td>
<td>1878</td>
<td>J.C.G. de Marignac</td>
<td>1906</td>
<td>C. A. von Welsbach</td>
<td>On October 22, 1878, Marignac reported splitting terbia into two new earths, terbia proper and ytterbia.</td>
</tr>
<tr>
<td>Holmium</td>
<td>1878</td>
<td>J.-L. Soret and M. Delafontaine</td>
<td>1879</td>
<td>T. Cleve</td>
<td>Soret found it in samarskite and later, Per Teodor Cleve split Marignac's erbia into erbia proper and two new elements, thulium and holmium. Delafontaine's philippium turned out to be identical to what Soret found.</td>
</tr>
<tr>
<td>Thulium</td>
<td>1879</td>
<td>T. Cleve</td>
<td>1879</td>
<td>T. Cleve</td>
<td>Cleve split Marignac's erbia into erbia proper and two new elements, thulium and holmium.</td>
</tr>
<tr>
<td>Scandium</td>
<td>1879</td>
<td>F. Nilson</td>
<td>1879</td>
<td>F. Nilson</td>
<td>Nilson split Marignac's ytterbia into pure ytterbia and a new element that matched Mendeleev's 1871 predicted eka-boron.</td>
</tr>
<tr>
<td>Samarium</td>
<td>1879</td>
<td>P.E.L. de Boisbaudran</td>
<td>1879</td>
<td>P.E.L. de Boisbaudran</td>
<td>Boisbaudran noted a new earth in samarskite and named it samaria after the mineral.</td>
</tr>
<tr>
<td>Gadolinium</td>
<td>1880</td>
<td>J. C. G. de Marignac</td>
<td>1886</td>
<td>P.E.L. de Boisbaudran</td>
<td>Marignac initially observed the new earth in terbia, and later Boisbaudran obtained a pure sample from samarskite.</td>
</tr>
<tr>
<td>Praseodymi</td>
<td>1885</td>
<td>C. A. von Welsbach</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number</td>
<td>Element</td>
<td>Year</td>
<td>Discoverer</td>
<td>Notes</td>
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<tr>
<td>--------</td>
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</tr>
<tr>
<td>60</td>
<td>Neodymium</td>
<td>1885</td>
<td>C. A. von Welsbach</td>
<td>Discovered two new distinct elements in Mosander's didymia: praseodymium and neodymium.</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Germanium</td>
<td>1886</td>
<td>C. A. Winkler</td>
<td>In February 1886 Winkler found in argyrodite the eka-silicon that Mendeleev had predicted in 1871.</td>
<td></td>
</tr>
<tr>
<td>66</td>
<td>Dysprosium</td>
<td>1886</td>
<td>P.E.L. de Boisbaudran</td>
<td>De Boisbaudran found a new earth in erbia.</td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Argon</td>
<td>1894</td>
<td>Lord Rayleigh and W. Ramsay</td>
<td>They discovered the gas by comparing the molecular weights of nitrogen prepared by liquefaction from air and nitrogen prepared by chemical means. It is the first noble gas to be isolated.</td>
<td></td>
</tr>
<tr>
<td>63</td>
<td>Europium</td>
<td>1896</td>
<td>E.-A. Demarçay</td>
<td>Demarçay found spectral lines of a new element in Lecoq's samarium, and separated this element several years later.</td>
<td></td>
</tr>
<tr>
<td>36</td>
<td>Krypton</td>
<td>1898</td>
<td>W. Ramsay and W. Travers</td>
<td>On May 30, 1898, Ramsay separated a noble gas from liquid argon by difference in boiling point.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Neon</td>
<td>1898</td>
<td>W. Ramsay and W. Travers</td>
<td>In June 1898 Ramsay separated a new noble gas from liquid argon by difference in boiling point.</td>
<td></td>
</tr>
<tr>
<td>54</td>
<td>Xenon</td>
<td>1898</td>
<td>W. Ramsay and W.</td>
<td>On July 12, 1898 Ramsay</td>
<td></td>
</tr>
<tr>
<td>Element</td>
<td>Year</td>
<td>Discoverer(s)</td>
<td>Discovery Information</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-----------</td>
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<td></td>
</tr>
<tr>
<td>Polonium</td>
<td>1898</td>
<td>P. and M. Curie</td>
<td>In an experiment done on July 13, 1898, the Curies noted an increased radioactivity in the uranium obtained from pitchblende, which they ascribed to an unknown element.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radium</td>
<td>1898</td>
<td>P. and M. Curie</td>
<td>The Curies reported on December 26, 1898, a new element different from polonium, which Marie later isolated from uraninite.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Radon</td>
<td>1899</td>
<td>E. Rutherford and R. B. Owens</td>
<td>Rutherford and Owens discovered a radioactive gas resulting from the radioactive decay of thorium, isolated later by Ramsay and Gray. In 1900, Friedrich Ernst Dorn discovered a longer-lived isotope of the same gas from the radioactive decay of radium. Since &quot;radon&quot; was first used to specifically designate Dorn's isotope before it became the name for the element, he is often mistakenly given credit for the latter instead of the former.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Actinium</td>
<td>1902</td>
<td>F. O. Giesel</td>
<td>Giesel obtained from pitchblende a substance that</td>
<td></td>
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</tr>
</tbody>
</table>
had properties similar to those of lanthanum and named it emanium. André-Louis Debierne had previously reported the discovery of a new element actinium that was supposedly similar to titanium and thorium; the elements were mistakenly identified as being identical and Debierne's name was chosen, even though in retrospect Debierne's substance could not have included much actual element 89.

<table>
<thead>
<tr>
<th>Element</th>
<th>Year</th>
<th>Discoverer</th>
<th>Year</th>
<th>Discoverer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lutetium</td>
<td>1906</td>
<td>C. A. von Welsbach and G. Urbain</td>
<td>1906</td>
<td>C. A. von Welsbach</td>
</tr>
<tr>
<td>von Welsbach proved that the old ytterbium also contained a new element, which he named cassiopeium. Urbain also proved this simultaneously, but his samples were very impure and only contained trace quantities of the new element. Despite this, his chosen name lutetium was adopted.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rhenium</td>
<td>1908</td>
<td>M. Ogawa</td>
<td>1919</td>
<td>M. Ogawa</td>
</tr>
<tr>
<td>Ogawa found it in thorianite but assigned it as element 43 instead of 75 and named it nipponium. In 1925 Walter Noddack, Ida Eva Tacke and Otto</td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>
Berg announced its separation from gadolinite and gave it the present name.

<table>
<thead>
<tr>
<th>Element</th>
<th>Year</th>
<th>Discoverer</th>
<th>Year</th>
<th>Discoverer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protactinium</td>
<td>1913</td>
<td>O. H. Göhring and K. Fajans</td>
<td>1927</td>
<td>A. von Grosse</td>
</tr>
<tr>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The two obtained the first isotope of this element that had been predicted by Mendeleev in 1871 as a member of the natural decay of (^{238}\text{U}). Originally isolated in 1900 by William Crookes, who nevertheless did not recognize that it was a new element.</td>
</tr>
<tr>
<td>Hafnium</td>
<td>1922</td>
<td>D. Coster and G. von Hevesy</td>
<td>1922</td>
<td>D. Coster and G. von Hevesy</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Georges Urbain claimed to have found the element in rare-earth residues, while Vladimir Vernadsky independently found it in orthite. Neither claim was confirmed due to World War I, and neither could be confirmed later, as the chemistry they reported does not match that now known for hafnium. After the war, Coster and Hevesy found it by X-ray spectroscopic analysis in Norwegian zircon. Hafnium was the last stable element to be discovered.</td>
</tr>
<tr>
<td>Technetium</td>
<td>1937</td>
<td>C. Perrier and E. Segrè</td>
<td>1937</td>
<td>C. Perrier &amp; E. Segrè</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>The two discovered a new element in a molybdenum sample that was used in a cyclotron, the</td>
</tr>
</tbody>
</table>
first synthetic element to be discovered, though it was later found out that it does occur naturally in minuscule trace quantities. It had been predicted by Mendeleev in 1871 as eka-manganese.

<table>
<thead>
<tr>
<th>Element</th>
<th>Period</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Discoverer(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>87 Francium</td>
<td>1939</td>
<td>M. Perey</td>
<td>Perey discovered it as a decay product of $^{227}$Ac. Francium was the last element to be discovered in nature, rather than synthesized in the lab, although four of the &quot;synthetic&quot; elements that were discovered later (plutonium, neptunium, astatine, and promethium) were eventually found in trace amounts in nature as well.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>93 Neptunium</td>
<td>1940</td>
<td>E.M. McMillan and H. Abelson</td>
<td>Obtained by irradiating uranium with neutrons, it is the first transuranium element discovered.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>61 Promethium</td>
<td>1942</td>
<td>S. Wu, E.G.</td>
<td>1945</td>
<td>Charles D.</td>
<td>It was probably first</td>
<td></td>
</tr>
<tr>
<td>#</td>
<td>Element</td>
<td>Year</td>
<td>Discoverers</td>
<td>Notes</td>
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<td>-----------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
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</tr>
<tr>
<td>96</td>
<td>Curium</td>
<td>1944</td>
<td>Glenn T. Seaborg, Ralph A. James and Albert Ghiorso</td>
<td>Prepared by bombarding plutonium with alpha particles during the Manhattan Project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>95</td>
<td>Americium</td>
<td>1944</td>
<td>G. T. Seaborg, R. A. James, O. Morgan and A. Ghiorso</td>
<td>Prepared by irradiating plutonium with neutrons during the Manhattan Project</td>
<td></td>
<td></td>
</tr>
<tr>
<td>97</td>
<td>Berkelium</td>
<td>1949</td>
<td>G. Thompson, A. Ghiorso and G. T. Seaborg (University of California, Berkeley)</td>
<td>Created by bombardment of americium with alpha particles.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>98</td>
<td>Californium</td>
<td>1950</td>
<td>S. G. Thompson, K. Street, Jr., A. Ghiorso and G. T. Seaborg (University of California, Berkeley)</td>
<td>Bombardment of curium with alpha particles.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>99</td>
<td>Einsteinium</td>
<td>1952</td>
<td>A. Ghiorso et al. (Argonne Laboratory, Los Alamos Laboratory and University of California, Berkeley)</td>
<td>Formed in the first thermonuclear explosion in November 1952, by irradiation of uranium with neutrons; kept secret for several years.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>100</td>
<td>Fermium</td>
<td>1952</td>
<td>A. Ghiorso et al. (Argonne Laboratory, Los Alamos Laboratory and University of California, Berkeley)</td>
<td>Formed in the first thermonuclear explosion in November 1952, by irradiation of uranium with neutrons; kept secret for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Element</td>
<td>Year</td>
<td>Preparation Method</td>
<td></td>
<td></td>
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<td>-------------</td>
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<td>-------------------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>Mendelevium</td>
<td>1955</td>
<td>Prepared by bombardment of einsteinium with helium.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lawrencium</td>
<td>1961</td>
<td>First prepared by bombardment of californium with boron atoms.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nobelium</td>
<td>1966</td>
<td>First prepared by bombardment of uranium with neon atoms.</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Rutherfordium</td>
<td>1969</td>
<td>Prepared by bombardment of californium with carbon atoms by Albert Ghiorso's team and by bombardment of plutonium with neon atoms by Zvara's team.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Dubnium</td>
<td>1970</td>
<td>Prepared by bombardment of californium with nitrogen atoms by Ghiorso's team and by bombardment of americium with neon atoms by Druin's team.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Seaborgium</td>
<td>1974</td>
<td>Prepared by bombardment of californium with oxygen atoms.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bohrium</td>
<td>1981</td>
<td>Obtained by bombarding bismuth with chromium.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meitnerium</td>
<td>1982</td>
<td>Prepared by bombardment of bismuth with iron atoms.</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Hassium</td>
<td>1984</td>
<td>Prepared by bombardment of</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
Timeline of the English Reformation

<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>1496</td>
<td>Catherine of Aragon's hand secured for Arthur, Prince of Wales, son of Henry VII</td>
</tr>
<tr>
<td>1501, October</td>
<td>Arthur marries Catherine</td>
</tr>
<tr>
<td>1502, April</td>
<td>Arthur dies of tuberculosis</td>
</tr>
<tr>
<td>1503</td>
<td>Henry VII's wife dies; considers taking Catherine, but decides to pass her to his son Henry VIII</td>
</tr>
<tr>
<td>1504</td>
<td>Pope Julius II confirms the marriage between Catherine and Arthur</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>----------------------</td>
<td>-----------------------------------------------------------------------</td>
</tr>
<tr>
<td>11 June 1509</td>
<td>Henry VIII marries Catherine</td>
</tr>
<tr>
<td>1514, December</td>
<td>A boy born to Catherine; dies 6 weeks later</td>
</tr>
<tr>
<td>18 February 1516</td>
<td>Princess Mary born</td>
</tr>
<tr>
<td>31 October 1517</td>
<td>Martin Luther posts his 95 Theses on the door of a church in Wittenberg, Germany, formally beginning the Protestant Reformation</td>
</tr>
<tr>
<td>1521</td>
<td>Pope Leo X rewards Henry VIII for his written attack on Luther by granting him the title &quot;Defender of the Faith&quot;</td>
</tr>
<tr>
<td>1524, May</td>
<td>William Tyndale expelled from the Catholic Church</td>
</tr>
<tr>
<td>1525</td>
<td>Thomas Cromwell helps to suppress 29 monasteries</td>
</tr>
<tr>
<td>1525</td>
<td>The New Testament of the <em>Tyndale Bible</em> (in English) is published in Worms, Germany.</td>
</tr>
<tr>
<td>1527</td>
<td>Henry VIII sure of intentions to divorce Catherine</td>
</tr>
<tr>
<td>1527, May</td>
<td>Catherine appeals to Rome</td>
</tr>
<tr>
<td>1529, June</td>
<td>Court opens in England for divorce case</td>
</tr>
<tr>
<td>1529, August</td>
<td>Peace of Cambrai</td>
</tr>
<tr>
<td>9 August 1529</td>
<td>Writs for new parliament; Thomas Wolsey removed as Lord Chancellor</td>
</tr>
<tr>
<td>9 October 1529</td>
<td>Wolsey charged on Praemunire</td>
</tr>
<tr>
<td>1530, April</td>
<td>Wolsey returns to his see at York</td>
</tr>
<tr>
<td>1530, Summer</td>
<td>Writs of Praemunire against 15 clergy</td>
</tr>
<tr>
<td>1530, November</td>
<td>Wolsey dies on his journey back to London and the Tower</td>
</tr>
<tr>
<td>1530</td>
<td>Cromwell part of the King's council's inner ring</td>
</tr>
<tr>
<td>1531</td>
<td>Henry makes claims to imperial title</td>
</tr>
<tr>
<td>1531</td>
<td>Henry extends protection to clergymen denying papal supremacy</td>
</tr>
<tr>
<td>1532</td>
<td>Duke of Norfolk, Duke of Suffolk, Earl of Wiltshire fall out of favour</td>
</tr>
<tr>
<td>1532, March</td>
<td>Supplication Against the Ordinaries</td>
</tr>
<tr>
<td>1532, March</td>
<td>Act in Conditional Restraint of Appeals</td>
</tr>
<tr>
<td>1532, May</td>
<td>Submission of the Clergy</td>
</tr>
<tr>
<td>16 May 1532</td>
<td>Thomas More resigns as Lord Chancellor of England</td>
</tr>
<tr>
<td>1532, December</td>
<td>Anne Boleyn becomes pregnant</td>
</tr>
<tr>
<td>1533, January</td>
<td>Thomas Cranmer appointed Archbishop of Canterbury</td>
</tr>
<tr>
<td>1533, 25 January</td>
<td>Henry VIII marries Anne Boleyn at Whitehall</td>
</tr>
<tr>
<td>1533, March</td>
<td>Statute in Restraint of Appeals</td>
</tr>
<tr>
<td>1533, May</td>
<td>Cranmer declares Henry's marriage null and void</td>
</tr>
<tr>
<td>1533, 4 July</td>
<td>John Frith burned at the stake</td>
</tr>
<tr>
<td>1533, September</td>
<td>Princess Elizabeth born</td>
</tr>
<tr>
<td>1534</td>
<td>Henry begins negotiations with Paul III</td>
</tr>
<tr>
<td>1534, January to</td>
<td>Act Concerning Ecclesiastical Appointments and Absolute Restraint of Annates, Act</td>
</tr>
<tr>
<td>Date</td>
<td>Event</td>
</tr>
<tr>
<td>--------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>March</td>
<td>Concerning Peter's Pence and Dispensations, Act of Succession</td>
</tr>
<tr>
<td>1534, March</td>
<td>Clement VII pronounces marriage valid</td>
</tr>
<tr>
<td>1534, April</td>
<td>Elizabeth Barton ('Nun of Kent') executed</td>
</tr>
<tr>
<td>1534, November</td>
<td>Act of Supremacy, Treason Act, Act of First Fruits and Tenths</td>
</tr>
<tr>
<td>1535</td>
<td>Henry adds &quot;of the Church of England in Earth, under Jesus Christ, Supreme Head&quot; to his royal style. Henry proclaims himself, not the Pope, to be the head of the Church of England</td>
</tr>
<tr>
<td>1535</td>
<td>Bishop Gardiner's <em>De Vera Obedientia</em> published</td>
</tr>
<tr>
<td>1535</td>
<td>The Coverdale Bible, compiled by Myles Coverdale published in Antwerp.</td>
</tr>
<tr>
<td>1535, May</td>
<td>Cromwell appoints Hugh Latimer, Edward Foxe, Nicholas Shaxton to episcopacy</td>
</tr>
<tr>
<td>1535, 22 June</td>
<td>Middlemore, Exmere, Newdigate locked up for seventeen days. Ten more starve</td>
</tr>
<tr>
<td>1535, 6 July</td>
<td>Thomas More executed</td>
</tr>
<tr>
<td>1536</td>
<td>Ten Articles; Act Extinguishing the Authority of the Bishop of Rome; Campeggio visits England</td>
</tr>
<tr>
<td>1536, January</td>
<td>Anne miscarries again</td>
</tr>
<tr>
<td>1536, March</td>
<td>First Act of Dissolution</td>
</tr>
<tr>
<td>19 May 1536</td>
<td>Anne Boleyn is executed</td>
</tr>
<tr>
<td>1536, April</td>
<td>'Reformation parliament' dissolved</td>
</tr>
<tr>
<td>1536, 1 October</td>
<td>Pilgrimage of Grace, Phase One</td>
</tr>
<tr>
<td>1536, 4 October</td>
<td>Pilgrimage of Grace led by 18 members of the gentry</td>
</tr>
<tr>
<td>1536, 13 October</td>
<td>York taken by 10,000 'pilgrims'</td>
</tr>
<tr>
<td>1536, 8 December</td>
<td>Duke of Norfolk offers pardon to rebels</td>
</tr>
<tr>
<td>1537</td>
<td><em>Bishops' Book</em> published, John Rogers produces the <em>Matthew Bible</em></td>
</tr>
<tr>
<td>1537, January</td>
<td>Bigod's Rebellion, a further phase of the Pilgrimage of Grace, led by Sir Francis Bigod</td>
</tr>
<tr>
<td>1537, 12 October</td>
<td>Jane Seymour gives birth to Prince Edward at Hampton Court Palace.</td>
</tr>
<tr>
<td>1538</td>
<td>'Exeter Conspiracy'</td>
</tr>
<tr>
<td>1539</td>
<td>Publication of the <em>Great Bible</em> compiled by Miles Coverdale</td>
</tr>
<tr>
<td>1539</td>
<td>Second Act of Dissolution; Henry VIII intervenes to halt the doctrinal reformation</td>
</tr>
<tr>
<td>1540, 6 January</td>
<td>Henry marries Anne of Cleves</td>
</tr>
<tr>
<td>1540, 9 July</td>
<td>Henry's marriage to Anne of Cleves is annulled</td>
</tr>
<tr>
<td>1540, 28 July</td>
<td>Thomas Cromwell is beheaded</td>
</tr>
<tr>
<td>1540, 30 July</td>
<td>Robert Barnes is burned at the stake</td>
</tr>
<tr>
<td>1540, 30 July</td>
<td>Thomas Abel is hanged, drawn and quartered.</td>
</tr>
<tr>
<td>1543</td>
<td>Cranmer is arrested on grounds of heresy, <em>The King's Book</em> is published</td>
</tr>
<tr>
<td>1544</td>
<td>Bishop Gardiner is targeted</td>
</tr>
<tr>
<td>1546</td>
<td>'Creeping to the Cross' added to the list of forbidden practises</td>
</tr>
<tr>
<td>Year</td>
<td>Event</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>1547, 28 January</td>
<td>Henry VIII dies, Edward VI accedes to the throne aged 9</td>
</tr>
<tr>
<td>1547</td>
<td>The First Book of Homilies introduced by Thomas Cranmer</td>
</tr>
<tr>
<td>1549</td>
<td>The First Book of Common Prayer is introduced by Thomas Cranmer and the Act of Uniformity 1549</td>
</tr>
<tr>
<td>1549</td>
<td>Putting away of Books and Images Act orders the removal of religious books and the destruction of images in churches</td>
</tr>
<tr>
<td>1549, June–August</td>
<td>The Prayer Book Rebellion in the West Country against the imposition of the new liturgy, especially amongst Cornish speakers who knew no English</td>
</tr>
<tr>
<td>1552</td>
<td>The Second Book of Common Prayer is introduced by Thomas Cranmer, the use of which is enforced by the Act of Uniformity 1552</td>
</tr>
<tr>
<td>1553, 6 July</td>
<td>Edward VI dies aged 15, leaving the throne to his Protestant cousin, Lady Jane Grey and excluding both his half-sisters.</td>
</tr>
<tr>
<td>1553, 19 July</td>
<td>Jane is deposed after the Catholic Princess Mary gathers military and popular support in Suffolk, arriving in London on 3 August</td>
</tr>
<tr>
<td>1553, December</td>
<td>First Statute of Repeal nullifies all religious legislation passed under Edward VI</td>
</tr>
<tr>
<td>1554, 26 January</td>
<td>Start of Wyatt's rebellion in protest at Mary's planned marriage to Prince Philip of Spain</td>
</tr>
<tr>
<td>1554, 12 February</td>
<td>Lady Jane Grey is executed</td>
</tr>
<tr>
<td>1554, 25 July</td>
<td>Mary marries her cousin Philip, who becomes King of England in a coregency with Mary</td>
</tr>
<tr>
<td>1554, 30 November</td>
<td>Mary persuades Parliament to request that the Papal Legate, Cardinal Reginald Pole, obtain Papal absolution for England's separation from the Catholic Church.</td>
</tr>
<tr>
<td>1554, November</td>
<td>Revival of the Heresy Acts restored the death penalty for those that denied the principles of Catholicism.</td>
</tr>
<tr>
<td>1555, January</td>
<td>Second Statute of Repeal removes all Protestant legislation passed since 1529</td>
</tr>
<tr>
<td>1555, 16 October</td>
<td>Former bishops Hugh Latimer and Nicholas Ridley were burned at the stake in Oxford.</td>
</tr>
<tr>
<td>1556, 21 March</td>
<td>Thomas Cranmer burned at the stake in Oxford.</td>
</tr>
<tr>
<td>1558, 17 November</td>
<td>Mary dies and her half-sister Elizabeth I accedes. Philip's English title lapses with the death of his wife.</td>
</tr>
<tr>
<td>1559, 15 January</td>
<td>Elizabeth is crowned. Because of her Protestant views, only the low-ranking Bishop of Carlisle is willing to officiate</td>
</tr>
<tr>
<td>1558-59</td>
<td>Elizabethan Religious Settlement, a compromise which secured Protestant reforms but allowed some Catholic traditions to continue.</td>
</tr>
<tr>
<td>1559</td>
<td>Act of Supremacy 1558 confirmed Elizabeth as Head of the Church of England and abolished the authority of the Pope in England.</td>
</tr>
<tr>
<td>1559</td>
<td>Act of Uniformity 1558 required attendances at services where a newly revised Book of Common Prayer was used.</td>
</tr>
<tr>
<td>1560</td>
<td><em>Geneva Bible</em> published in Switzerland</td>
</tr>
</tbody>
</table>
### Timeline of human vaccines

#### 18th century

- 1796 Edward Jenner develops and documents first vaccine for smallpox.

#### 19th century

- 1884 First vaccine for cholera by Jaume Ferran i Clua
- 1885 First vaccine for rabies by Louis Pasteur and Émile Roux
- 1890 First vaccine for tetanus (serum antitoxin) by Emil von Behring
- 1896 First vaccine for typhoid fever by Almroth Edward Wright, Richard Pfeiffer, and Wilhelm Kolle
- 1897 First vaccine for bubonic plague by Waldemar Haffkine

#### 20th century

- 1921 First vaccine for tuberculosis by Stamen Grigorov
- 1923 First vaccine for diphtheria by Emil von Behring and Kitasato Shibasaburō
- 1924 First vaccine for scarlet fever by George F. Dick and Gladys Dick
- 1924 First inactive vaccine for tetanus (tetanus toxoid, TT) by P. Descombey
- 1926 First vaccine for pertussis (whooping cough) by Leila Denmark
- 1932 First vaccine for yellow fever by Max Theiler
- 1937 First vaccine for typhus by Rudolf Weigl, Ludwik Fleck and Hans Zinsser
- 1937 First vaccine for influenza by Anatol Smorodintsev
- 1941 First vaccine for tick-borne encephalitis
- 1952 First vaccine for polio (Salk vaccine)
- 1954 First vaccine for Japanese encephalitis
- 1954 First vaccine for anthrax
- 1957 First vaccine for adenovirus-4 and 7
- 1962 First oral polio vaccine (Sabin vaccine)
- 1963 First vaccine for measles
- 1967 First vaccine for mumps
- 1970 First vaccine for rubella
- 1974 First vaccine for chicken pox
- 1977 First vaccine for pneumonia (*Streptococcus pneumoniae*)
- 1978 First vaccine for meningitis (*Neisseria meningitidis*)
- 1980 Smallpox declared eradicated worldwide due to vaccination efforts
- 1981 First vaccine for hepatitis B (first vaccine to target a cause of cancer)
- 1985 First vaccine for *Haemophilus influenzae* type b (HiB)
- 1989 First vaccine for Q fever
- 1991 First vaccine for hepatitis A
- 1998 First vaccine for Lyme disease
- 1998 First vaccine for rotavirus

21st century

- 2003 First nasal influenza vaccine approved in U.S. (FluMist)
- 2006 First vaccine for human papillomavirus (which is a cause of cervical cancer)
• 2012 First vaccine for hepatitis E
• 2012 First quadrivalent (4-strain) influenza vaccine
• 2015 First vaccine for enterovirus 71, one cause of hand foot mouth disease
• 2015 First vaccine for malaria
• 2015 First vaccine for dengue fever.
• 2019 First vaccine for ebola approved.

List of inventors

• Vitaly Abalakov (1906–1986), Russia – camming devices, Abalakov thread (or V-thread) gearless ice climbing anchor
• Ernst Karl Abbe (1840–1905), Germany – Condenser (microscope), apochromatic lens, refractometer
• Hovannes Adamian (1879–1932), USSR/Russia – tricolor principle of the color television
• Samuel W. Alderson (1914–2005), U.S. – Crash test dummy
• Alexandre Alexeieff (1901–1982), Russia/France – Pinscreen animation (with his wife Claire Parker)
• Rostislav Alexeyev (1916–1980), Russia/USSR – Ekranoplan
• Randi Altschul (born 1960), U.S. – Disposable cellphone
• Bruce Ames (born 1928), U.S. – Ames test (Cell biology)
• Giovanni Battista Amici (1786–1863), Italy – Dipleidoscope, Amici prism
• Ruth Amos (born 1989), British – StairSteady
• Mary Anderson (1866–1953), United States – windshield wiper blade
• Momofuku Ando (1910–2007), Japan – Instant noodles
• Hal Anger (1920–2005), U.S. – Well counter (radioactivity measurements), gamma camera
• Anders Knutsson Ångström (1888–1981), Sweden – Pyranometer
• Ottomar Anschütz (1846–1907), Germany – single-curtain focal-plane shutter, electrotachyscope
• Hermann Anschütz-Kaempfe (1872–1931), Germany – Gyrocompass
• Virginia Apgar (1909–1974), U.S. – Apgar score (for newborn babies)
• Nicolas Appert (1749–1841), France – canning (food preservation) using glass bottles, see also Peter Durand
• Archimedes (c. 287–212 BC), Greece – Archimedes' screw
• Guido of Arezzo (c. 991–c. 1033), Italy – Guidonian hand, musical notation, see also staff (music)
• Ami Argand (1750–1803), France – Argand lamp
• William George Armstrong (1810–1900), UK – hydraulic accumulator
• Neil Arnott (1788–1874), UK – waterbed
• Terry Keith Ashwin (born 1956), South Africa – Link-It
• Joseph Aspdin (1788–1855), UK – Portland cement
• Charles Babbage (1791–1871), UK – Analytical engine (semi-automatic)
• Tabitha Babbitt (1779–1853), U.S. – Saw mill circular saw
• Victor Babes (1854–1926), Romania – Babesia, the founder of serum therapy
• Leo Baekeland (1863–1944), Belgian–American – Velox photographic paper and Bakelite
• Ralph H. Baer (1922–2014), German born American – video game console
• Adolf von Baeyer (1835–1917), Germany – Fluorescein, synthetic Indigo dye, Phenolphthalein
• John Logie Baird (1888–1946), Scotland – an electromechanical television, electronic color television
• Abi Bakr of Isfahan (c. 1235), Persia/Iran – mechanical geared astrolabe with lunisolar calendar
• George Ballas (1925–2011), U.S. – String trimmer
• Frederick Banting (1891–1941), Canada – Insulin
• Vladimir Baranov-Rossine (1888–1944), Russia/France – Optophonic Piano
• John Barber (1734–1801), UK – gas turbine
• John Bardeen (1908–1991), U.S. – co-inventor of the transistor, with Brattain and Schockley
• Vladimir Barmin (1909–1993), Russia – first rocket launch complex (spaceport)
• Anthony R. Barringer (1925–2009), Canada/U.S. – INPUT (Induced Pulse Transient) airborne electromagnetic system
• Nikolay Basov (1922–2001), Russia – co-inventor of laser and maser
• Émile Baudot (1845–1903), France – Baudot code
• Eugen Baumann (1846–1896), Germany – PVC
• Trevor Baylis (1937–2018), UK – a wind-up radio
• Maria Beasley (1847–1904), U.S. – barrel-hooping machine, improved life raft
- Francis Beaufort (1774–1857), Ireland/UK – Beaufort scale, Beaufort cipher
- Arnold O. Beckman (1900–2004), U.S. – electric pH meter
- Vladimir Bekhterev (1857–1927), Russia – Bekhterev's Mixture
- Josip Belušić (1847–?), Croatia – electric speedometer
- Alexander Graham Bell (1847–1922), UK, Canada, and U.S. – telephone
- Nikolay Benardos (1842–1905), Russian Empire – arc welding (specifically carbon arc welding, the first arc welding method)
- Miriam Benjamin (1861–1947), Washington, D.C. – Gong and signal chair (adopted by House of Representatives and precursor to flight attendant signal system)
- Melitta Bentz (1873–1950), Germany – paper Coffee filter
- Karl Benz (1844–1929), Germany – the petrol-powered automobile
- Hans Berger (1873–1941), Germany – first human EEG and its development
- Friedrich Bergius (1884–1949), Germany – Bergius process (synthetic fuel from coal)
- Emile Berliner (1851–1929), Germany and U.S. – the disc record gramophone
- Tim Berners-Lee (born 1955), UK – with Robert Cailliau, the World Wide Web
- Marcellin Berthelot (1827–1907), France – Berthelot's reagent (chemistry)
- Heinrich Bertsch (1897–1981), Germany – first fully synthetic laundry detergent "Fewa" (chemistry)
- Charles Best (1899–1978), Canada – Insulin (chemistry)
- Max Bielschowsky (1869–1940), Germany – Bielschowsky stain (histology)
- Alfred Binet (1857–1911), France – with his student Théodore Simon (1872–1961), first practical Intelligence test
- Lucio Bini (1908–1964), together with Ugo Cerletti (1877–1963), Italy – Electroconvulsive therapy
- Gerd Binnig (born 1947), with Christoph Gerber, Calvin Quate and Heinrich Rohrer, Germany/Switzerland/U.S. – Atomic force microscope and Scanning tunneling microscope
- Clarence Birdseye (1886–1956), U.S. – Flash freezing
- László Biró (1899–1985), Hungary – Ballpoint pen
- Thor Bjorklund (1889–1975), Norway – Cheese slicer
- J. Stuart Blackton (1875–1941), U.S. – Stop-motion film
• Otto Blathy (1860–1939), Hungary – co-inventor of the transformer, wattmeter, alternating current (AC) and turbogenerator
• John Blenkinsop (1783–1831), UK – Blenkinsop rack railway system
• Charles K. Bliss (1897–1985), Austro-Hungary/Australia – Blissymbols
• Katharine B. Blodgett (1898–1979), UK – nonreflective glass
• Alan Blumlein (1903–1942), UK – stereo
• David Boggs (born 1950), U.S. – Ethernet
• Nils Bohlin (1920–2002), Sweden – the three-point seat belt
• Charlie Booth (1903–2008), Australia – Starting blocks
• Sam Born (1891–1959), Russia/U.S. – lollipop-making machine
• Jagdish Chandra Bose (1858–1937), India – Crescograph
• Matthew Piers Watt Boulton (1820–1894), UK – aileron
• Seth Boyden (1788–1870), U.S. – nail-making machine
• Herbert Boyer (born 1936), together with Paul Berg (1926–), and Stanley Norman Cohen (1935–), U.S. – created first Genetically modified organism
• Willard Boyle (1924–2011), together with George E. Smith (1930–), U.S. – Charge-coupled device (CCD)
• Hugh Bradner (1915–2008), U.S. – Wetsuit
• Louis Braille (1809–1852), France – Braille writing system, Braille musical notation
• Jacques E. Brandenberger (1872–1954), Switzerland – Cellophane
• Édouard Branly (1844–1940), France – Coherer
• Charles F. Brannock (1903–1992), U.S. – Brannock Device (shoe size)
• Walter Houser Brattain (1902–1987), U.S. – co-inventor of the transistor
• Karl Ferdinand Braun (1850–1918), Germany – cathode-ray tube oscilloscope
• Stanislav Brebera (1925–2012), Czech Republic – Semtex explosive
• David Brewster (1781–1868), United Kingdom – Kaleidoscope
• Rachel Fuller Brown (1898–1980), U.S. – Nystatin, the world's first antifungal antibiotic
• William C. Brown (1916–1999), U.S. – Crossed-field amplifier
• Marie Van Brittan Brown (1922–1999), U.S. – home security system
• Friedrich Wilhelm Gustav Bruhn (1853–1927), Germany – Taximeter
• Nikolay Brusentsov (1925–2014), USSR, Russia – ternary computer (Setun)
• Dudley Allen Buck (1927–1959), U.S. – Cryotron, content-addressable memory
• Edwin Beard Budding (1795–1846), UK – lawnmower
• Gersh Budker (1918–1977), Russia – electron cooling, co-inventor of collider
• Edward Bull (c.1759–1798), England – Bull engine (a modified steam engine)
• Robert Bunsen (1811–1899), Germany – Bunsen burner
• Henry Burden (1791–1871) Scotland and U.S. – Horseshoe machine, first usable iron railroad spike
• Robert Cailliau (born 1947), Belgium – with Tim Berners-Lee, the World Wide Web
• Edward A. Calahan (1838–1912), U.S. – Stock ticker tape
• Nicholas Callan (1799–1864), Ireland – Induction coil
• Tullio Campagnolo (1901–1983), Italy – Quick release skewer
• Charles Cantor (born 1942), U.S. – Pulsed-field gel electrophoresis (molecular biology)
• Mario Ramberg Capecchi (born 1937), together with Sir Martin John Evans (born 1941), and Oliver Smithies (born 1925), U.S. – Gene targeting
• Arturo Caprotti (1881–1938), Italy – Caprotti valve gear
• Gerolamo Cardano (1501–1576), Italy – Cardan grille (cryptography)
• Philip Cardew (1851–1910), UK – Hot-wire galvanometer
• Chester Carlson (1906–1968), U.S. – Xerographic copier
• Wallace Carothers (1896–1937), U.S. – Nylon and Neoprene (together with Arnold Collins)
• Antonio Benedetto Carpano (1764–1815), Italy – Vermouth
• Giovanni Caselli (1815–1891), Italy/France – Pantelegraph
• George Cayley (1773–1857), UK – tension-spoke wheels
• Anders Celsius (1701–1744), Sweden – Celsius temperature scale
• Vint Cerf (born 1943), together with Bob Kahn (1938–), U.S. – Internet Protocol (IP)
• Ugo Cerletti (1877–1963), together with Lucio Bini (1908–1964), Italy – Electroconvulsive therapy
• Charles Chamberland (1851–1908), France – Chamberland filter
• Min Chueh Chang (1908–1991), together with Gregory Goodwin Pincus (1903–1967), U.S./China – Combined oral contraceptive pill
• Thomas Chang (born 1933), Canada/China – Artificial cell
• Emmett Chapman (born 1936), US – Chapman Stick
• Claude Chappe (1763–1805), France – Semaphore line
• David Chaum (born 1955), U.S. – Digital signatures, ecash
• Vladimir Chelomey (1914–1984), USSR – First space station (Salyut)
• Pavel Cherenkov (1904–1990), USSR – Cherenkov detector
• Evgeniy Chertovsky (born 1902-Unknown), Russia – pressure suit
• Ward Christensen (born 1945), U.S. – Bulletin board system
• Ole Kirk Christiansen (1891–1958), Denmark – Creator of Lego
• Samuel Hunter Christie (1784–1865), UK – Wheatstone bridge
• Juan de la Cierva (1895–1936), Spain – the autogyro
• Charles Clagget (1740–1795), UK – Improvements for musical instruments
• Leland Clark (1918–2005), U.S. – Clark electrode (medicine)
• Georges Claude (1870–1960), France – neon lamp
• Henri Marie Coandă (1886–1972), Romania – Coandă effect
• Josephine Cochrane (1839–1913), U.S. – dishwasher
• Christopher Cockerell (1910–1999), UK – Hovercraft
• Aeneas Coffey (1780–1852), Ireland – Coffey still
• Sir Henry Cole (1808–1882), UK – Christmas card
• Samuel Colt (1814–1862), U.S. – Revolver development
• Sir William Congreve (1772–1828), UK – Congreve rocket
• George Constantinescu (1881–1965), Romania – creator of the theory of sonics, a new branch of continuum mechanics
• Albert Coons (1912–1978), U.S. – Immunofluorescence (microscopy)
• Martin Cooper (born 1928), U.S. – Mobile phone
• Harry Coover (1917–2011), U.S. – Super Glue
• Lloyd Groff Copeman (1865–1956), U.S. – Electric stove
• Cornelis Corneliszoon (1550–1607), The Netherlands – wind powered sawmill
• Alexander Coucoulas (born 1933), U.S. – Thermosonic bonding
• Jacques Cousteau (1910–1997), France – co-inventor of the aqualung and the Nikonos underwater camera
• John "Jack" Higson Cover Jr. (1920–2009), U.S. – Taser
• William Crookes (1832–1919), UK – Crookes radiometer, Crookes tube
• Bartolomeo Cristofori (1655–1731), Italy – piano
• S. Scott Crump (inv. c. 1989), U.S. – Fused deposition modeling
• Nicolas-Joseph Cugnot (1725–1804), France – First steam-powered road vehicle
• William Cullen (1710–1790), UK – First artificial refrigerator
• Jan Czochralski (1885–1953), Poland / Germany – Czochralski process (crystal growth)
• Nils Gustaf Dalén (1869–1937), Sweden – AGA cooker, Dalén light, Agamassan, Sun valve for lighthouses and buoys
• John Frederic Daniell (1790–1845), United Kingdom – Daniell cell
• Corradino D’Ascanio (1891–1981), Italy – Vespa scooter
• Leonardo da Vinci (1452–1519), Italy – helicopter, tanks, and parachutes for safety
• Jacob Davis (1868–1908), U.S. – Riveted jeans
• Humphry Davy (1778–1829), UK – Davy miners lamp
• Joseph Day (1855–1946), UK – the crankcase-compression two-stroke engine
• Lee DeForest (1873–1961), U.S. – Phonofilm, triode
• Fe del Mundo (1911–2011), Philippines – non-electric incubator
• Yuri Nikolaevich Denisyuk (1927–2006), Russia – 3D holography
• Robert H. Dennard (born 1932), U.S. – Dynamic random-access memory (DRAM)
• Miksa Deri (1854–1938), Hungary – co-inventor of an improved closed-core transformer
• James Dewar (1842–1923), UK – Thermos flask
• Aleksandr Dianin (1851–1918), Russia – Bisphenol A, Dianin’s compound
• William Kennedy Laurie Dickson (1860–1935), UK – motion picture camera
• Philip Diehl (1847–1913), U.S. – Ceiling fan
• Rudolf Diesel (1858–1913), Germany – Diesel engine
• William H. Dobelle (1943–2004), United States – Dobelle Eye
• Johann Wolfgang Döbereiner (1780–1849), Germany – Döbereiner's lamp (chemistry)
• Toshitada Doi (born 1943), Japan, together with Joop Sinjou, Netherlands – Compact disc
• Ray Dolby (1933–2013), U.S. – Dolby noise-reduction system
• Gene Dolgoff (born 1950), U.S. – LCD projector
• Mikhail Dolivo-Dobrovolsky (1862–1919), Poland/Russia – three-phase electric power
• Marion O’Brien Donovan (1917–1998), U.S. – Waterproof diaper
• Hub van Doorne (1900–1979), Netherlands, Variomatic continuously variable transmission
• John Thompson Dorrance (1873–1930), U.S. – Condensed soup
• Amanda Minnie Douglas (1831–1916), writer and inventor (portable folding mosquito net frame)
• Charles Dow (1851–1902), U.S. – Dow Jones Industrial Average
• Mulalo Doyoyo (born 1970), South Africa/U.S. – Cenocell – cementless concrete
• Anastase Dragomir (1896–1966), Romania – Ejection seat
• Karl Drais (1785–1851), Germany – dandy horse, Draisine
• Richard Drew (1899–1980), U.S. – Masking tape
• John Boyd Dunlop (1840–1921), UK – first practical pneumatic tyre
• Cyril Duquet (1841–1922), Canada – Telephone handset
• Alexey Dushkin (1904–1977), Russia – deep column station
• James Dyson (born 1947), UK – Dual Cyclone bagless vacuum cleaner, incorporating the principles of cyclonic separation.
• George Eastman (1854–1932), U.S. – roll film
• Thomas Alva Edison (1847–1931), U.S. – phonograph, commercially practical incandescent light bulb, etc.
• Pehr Victor Edman (1916–1977), Sweden – Edman degradation for Protein sequencing
• Sir Robert Geoffrey Edwards (1925–2013), United Kingdom – In vitro fertilisation
• Ellen Eglin (1849–c. 1890), U.S. – Clothes wringer
• Brendan Eich (born 1961), U.S. – JavaScript (programming language)
• Willem Einthoven (1860–1927), The Netherlands – the electrocardiogram
• Benjamin Eisenstadt (1906–1996), U.S. – Sugar packet
• Paul Eisler (1907–1992), Austria/U.S. – Printed circuit board (electronics)
• Giorgi Eliava (1892–1937), together with Félix d'Herelle (1873–1949), France / Georgia – Phage therapy
• Ivan Elmanov, Russia – first monorail (horse-drawn)
• Rune Elmqvist (1906–1996), Sweden – implantable pacemaker
• John Haven Emerson (1906–1997), U.S. – iron lung
• Douglas Engelbart (1925–2013), U.S. – the computer mouse
• John Ericsson (1803–1889), Sweden – the two screw-propeller
• Emil Erlenmeyer (1825–1909), Germany – Erlenmeyer flask
• Sir Martin John Evans (born 1941), together with Mario Ramberg Capecchi (born 1937), and Oliver Smithies (1925–2017), U.S. – Knockout mouse, Gene targeting
• Ole Evinrude (1877–1934), Norway – outboard motor
• Charles Fabry (1867–1945), together with Alfred Perot (1863–1925), France – Fabry–Pérot interferometer (physics)
• Samuel Face (1923–2001), U.S. – concrete flatness/levelness technology; Lightning Switch
• Federico Faggin (born 1941), Italy – microprocessor
• Daniel Gabriel Fahrenheit (1686–1736), The Netherlands – Fahrenheit temperature scale, Mercury-in-glass thermometer
• Michael Faraday (1791–1867), UK – electric transformer, electric motor
• Johann Maria Farina (1685–1766), Germany; Eau de Cologne
• Myra Juliet Farrell (1878–1957), Australia – stitchless button, Press stud
• Philo Farnsworth (1906–1971), U.S. – electronic television
• Muhammad al-Fazari (died 796/806), Persia – astrolabe
• John Bennett Fenn (1917–2010), U.S. – Electrospray ionization
• Henry John Horstman Fenton (1854–1929), UK – Fenton's reagent (chemistry)
• James Fergason (1934–2008), U.S. – improved liquid crystal display
• Enrico Fermi (1901–1954), Italy – nuclear reactor
• Humberto Fernández-Morán (1924–1999), Venezuela – Diamond scalpel, Ultra microtome
• Michele Ferrero (1925–2012), Italy – Kinder Surprise = Kinder Eggs, Nutella
• Bran Ferren (born 1953), U.S. – Pinch-to-zoom (multi-touch), together with Daniel Hillis
• Reginald Fessenden (1866–1932), Canada – two-way radio
• Robert Feulgen (1884–1955), Germany – Feulgen stain (histology)
• Adolf Gaston Eugen Fick (1829–1901), Germany – contact lens
• Abbas Ibn Firnas (810–887), Al-Andalus – fused quartz and silica glass, metronome
• Artur Fischer (1919–2016) Germany – fasteners including fischertechnik.
• Franz Joseph Emil Fischer (1877–1947), together with Hans Schrader (1921–2012), Germany – Fischer assay (oil yield test)
• Franz Joseph Emil Fischer (1877–1947), together with Hans Tropsch (1889–1935), Germany – Fischer–Tropsch process (refinery process)
• Gerhard Fischer (1899–1988), Germany/U.S. – hand-held metal detector
• Paul C. Fisher (1913–2006), U.S. – Space Pen
• Alexander Fleming (1881–1955), Scotland – Penicillin
- John Ambrose Fleming (1848–1945), UK – Vacuum diode
- Sandford Fleming (1827–1915), Canada – Universal Standard Time
- Nicolas Florine (1891–1972), Georgia/Russia/Belgium – first tandem rotor helicopter to fly freely
- Thomas J. Fogarty (born 1934), U.S. – Embolectomy catheter (medicine)
- Enrico Forlanini (1848–1930), Italy – Steam helicopter, hydrofoil, Forlanini airships
- Eric Fossum (born 1957), U.S. – intra-pixel charge transfer in CMOS image sensors
- Jean Bernard Léon Foucault (1819–1868), France – Foucault pendulum, gyroscope, eddy current
- Benoît Fourneyron (1802–1867), France – water turbine
- John Fowler (1826–1864), UK – steam-driven ploughing engine
- Benjamin Franklin (1706–1790), U.S. – the pointed lightning rod conductor, bifocal glasses, the Franklin stove, the glass harmonica
- Herman Frasch (1851–1914), Germany / U.S. – Frasch process (petrochemistry), Paraffin wax purification
- Ian Hector Frazer (born 1953), together with Jian Zhou (1957–1999), U.S./China – HPV vaccine against cervical cancer
- Augustin-Jean Fresnel (1788–1827), France – Fresnel lens
- William Friese-Greene (1855–1921), UK – cinematography
- Julius Fromm (1883–1945), Germany – first seamless Condom
- Arthur Fry (born 1931), U.S. – Post-it note
- Buckminster Fuller (1895–1983), U.S. – geodesic dome
- C. W. Fuller (inv. 1953), U.S. – Gilhoolie
- Robert Fulton (1765–1815), United States – first commercially successful steamboat, first practical submarine
- Ivan Fyodorov (c. 1510–1583), Russia/Poland–Lithuania – invented multibarreled mortar, introduced printing in Russia
- Svyatoslav Fyodorov (1927–2000), Russia – radial keratotomy
- Vladimir Fyodorov (1874–1966), Russia – Fedorov Avtomat (first self-loading battle rifle, arguably the first assault rifle)
- Dennis Gabor (1900–1979), Hungarian-British – holography
- Boris Borisovich Galitzine (1862–1916), Russia – electromagnetic seismograph
- Joseph G. Gall (born 1928), U.S. – In situ hybridization (cell biology)
• Alfred William Gallagher (1911–1990), New Zealand – Electric fence for farmers
• Dmitri Garbuzov (1940–2006), Russia/U.S. – continuous-wave-operating diode lasers (together with Zhores Alferov), high-power diode lasers
• Elmer R. Gates (1859–1923), U.S. – foam fire extinguisher, electric loom mechanisms, magnetic & diamagnetic separators, educational toy ("box & blocks")*
• Richard J. Gatling (1818–1903), U.S. – wheat drill, first successful machine gun
• Georgy Gause (1910–1986), Russia – gramicidin S, neomycin, lincomycin and other antibiotics
• E. K. Gauzen, Russia – three bolt equipment (early diving costume)
• Norman Gaylord (1923–2007), U.S. – rigid gas-permeable contact lens
• Karl-Hermann Geib (1908–1949), Germany / USSR – Girdler sulfide process
• Hans Wilhelm Geiger (1882–1945), Germany – Geiger counter
• Andrey Geim (born 1958), Russia/United Kingdom – graphene
• Nestor Genko (1839–1904), Russia – Genko's Forest Belt (the first large-scale windbreak system)
• Christoph Gerber (1942–), with Calvin Quate (1923–), and with Gerd Binnig (1947–), Germany/U.S./Switzerland – Atomic force microscope
• Friedrich Clemens Gerke (1801–1888), Germany – current international Morse code
• David Gestetner (1854–1939), Austria-Hungary / UK – Gestetner copier
• Alberto Gianni (1891–1930), Italy – Torretta butoscopica
• John Heysham Gibbon (1903–1973), U.S. – Heart-lung machine
• Gustav Giemsa (1867–1948), Germany – Giemsa stain (histology)
• Adolph Giesl-Gieslingen (1903–1992), Austria – Giesl ejector
• Henri Giffard (1825–1882), France – powered airship, injector
• David J. Gingery (1932–2004), USA
• Donald A. Glaser (1926–2013), U.S. – Bubble chamber
• Joseph Glass (1791–1867), England – chimney-sweeping apparatus
• Valentyn Glushko (1908–1989), Russia – hypergolic propellant, electric propulsion, Soviet rocket engines (including world's most powerful liquid-fuel rocket engine RD-170)
• Heinrich Göbel (1818–1893), Germany – incandescent lamp
• Leonid Gobyato (1875–1915), Russia – man-portable mortar
• Robert Goddard (1882–1945), U.S. – liquid fuel rocket
• Sam Golden (1915–1997), together with Leonard Bocour (1910–1993), U.S. – Acrylic paint
- Peter Carl Goldmark (1906–1977), Hungary – vinyl record (LP), CBS color television
- Camillo Golgi (1843–1926), Italy – Golgi's method (histology)
- Lewis Gompertz (c. 1783—1861), UK – expanding chuck, improved velocipede
- Charles Goodyear (1800–1860), U.S. – vulcanization of rubber
- Praveen Kumar Gorakavi (born 1989), India – low-cost Braille Typewriter
- Robert W. Gore (born 1937), United States – Gore-Tex
- Igor Gorynin (1926–2015), Russia – weldable titanium alloys, high strength aluminium alloys, radiation-hardened steels
- James Gosling (born 1955), U.S. – Java (programming language)
- Gordon Gould (1920–2005), U.S. – Laser, see also Theodore Maiman
- Richard Hall Gower (1768–1833), UK – ship's hull and rigging
- Boris Grabovsky (1901–1966), Russia – cathode commutator, an early electronic TV pickup tube
- Bette Nesmith Graham (1924–1980), U.S. – Correction fluid, Liquid Paper
- Hans Christian Gram (1853–1938), Denmark / Germany – Gram staining (histology)
- Zénobe Gramme (1826–1901), Belgium/France – Gramme dynamo
- Temple Grandin (born 1947), Inventor of the squeeze machine and humane abattoirs.
- Michael Grätzel (born 1944), Germany/Switzerland – Dye-sensitized solar cell
- James Henry Greathead (1844–1896), South Africa – tunnel boring machine, tunnelling shield technique
- Chester Greenwood (1858–1937), U.S. – thermal earmuffs
- Lori Greiner (born 1969), U.S. – Silver Safekeeper anti-tarnish lining (jewelry organizers) and multiple consumer products, 120 US and foreign patents
- James Gregory (1638–1675), Scotland – Gregorian telescope
- William Griggs (1832–1911), England – a process of photolithography
- William Robert Grove (1811–1896), Wales – fuel cell
- Gustav Guanella (1909–1982), Switzerland – DSSS, Guanella-Balun
- Otto von Guericke (1602–1686), Germany – vacuum pump, manometer, dasymeter
- Mikhail Gurevich (1893–1976), Russia – MiG-series fighter aircraft, including world's most produced jet aircraft MiG-15 and most produced supersonic aircraft MiG-21 (together with Artem Mikoyan)
- Goldsworthy Gurney (1793–1875), England – Gurney Stove
• Bartolomeu de Gusmão (1685–1724), Brazil – early air balloons
• Johann Gutenberg (c. 1398–1468), Germany – movable type printing press
• Samuel Guthrie (physician) (1782–1848), U.S. – discovered chloroform
• Fritz Haber (1868–1934), Germany – Haber process (ammonia synthesis)
• John Hadley (1682–1744), UK – Octant
• Waldemar Haffkine (1860–1930), Russia/Switzerland – first anti-cholera and anti-plague vaccines
• Gunther von Hagens (born 1945), Germany – whole body Plastination
• Charles Hall (1863–1914), U.S. – aluminum production
• Robert N. Hall (1919–2016), U.S. – Semiconductor laser
• Tracy Hall (1919–2008), U.S. – synthetic diamond
• Nicholas Halse (died 1636), England – malt kiln
• Richard Hamming (1915–1998), U.S. – Hamming code
• John Hays Hammond Jr. (1888–1965), U.S. – radio control
• Ruth Handler (1916–2002), U.S. – Barbie doll
• James Hargreaves (1720–1778), UK – spinning jenny
• John Harington (1561–1612), UK – the flush toilet
• William Snow Harris (1791–1867), United Kingdom – much improved naval Lightning rods
• John Harrison (1693–1776), UK – marine chronometer
• Ross Granville Harrison (1870–1959), U.S. – first successful animal Tissue culture, Cell culture
• Kazuo Hashimoto (died 1995), Japan – Caller-ID, answering machine
• Victor Hasselblad (1906–1978), Sweden – invented the 6 x 6 cm single-lens reflex camera
• Ibn al-Haytham (Alhazen) (965–1039), Iraq – camera obscura, pinhole camera, magnifying glass
• Zheng He (1371–1433), China – Chinese treasure ship
• George H. Heilmeier (1936–2014), U.S. – liquid crystal display (LCD)
• Henry Heimlich (1920–2016), U.S. – Heimlich maneuver
• Robert A. Heinlein (1907–1988), U.S. – waterbed
• Jozef Karol Hell (1713–1789), Slovakia – the water pillar
• Rudolf Hell (1901–2002), Germany – the Hellschreiber
• Hermann von Helmholtz (1821–1894), Germany – Helmholtz pitch notation, Helmholtz resonator, ophthalmoscope
• Zhang Heng (78–139), China – Seismometer, first hydraulic-powered armillary sphere
• Beulah Louise Henry (1887–1973), U.S. – bobbin-free sewing machine, vacuum ice cream freezer
• Charles H. Henry (born 1937), U.S. – Quantum well laser
• Joseph Henry (1797–1878), Scotland/U.S. – electromagnetic relay
• Félix d'Herelle (1873–1949), together with Giorgi Eliava (1892–1937), France / Georgia – Phage therapy
• Heron (c. 10–70), Roman Egypt – usually credited with invention of the aeolipile, although it may have been described a century earlier
• John Herschel (1792–1871), UK – photographic fixer (hypo), actinometer
• Harry Houdini (1874–1926) U.S. – flight time illusion
• Heinrich Hertz (1857–1894), Germany – radio telegraphy, electromagnetic radiation
• Ephraim Hertzano (around 1950), Roumania / Israel – Rummikub
• Lasse Hessel (born 1940), Denmark – Female condom
• George de Hevesy (1885–1966), Hungary – radioactive tracer
• Ronald Price Hickman (1932–2011), U.S. – designed the original Lotus Elan, the Lotus Elan +2 and the Lotus Europa, as well as the Black & Decker Workmate
• Rowland Hill (1795–1879), UK – postage stamp
• Maurice Hilleman (1919–2005) – vaccines against childhood diseases
• Tanaka Hisashige (1799–1881), Japan – Myriad year clock
• Ted Hoff (born 1937), U.S. – microprocessor
• Felix Hoffmann (Bayer) (1868–1949), Germany – Aspirin
• Albert Hofmann (1906–2008), Switzerland – LSD
• Kotaro Honda (1870–1954), Japan – KS steel
• Huang Hongjia (born 1924), China – Single-mode optical fiber.
• Herman Hollerith (1860–1929), U.S. – recording data on a machine readable medium, tabulator, punched cards
• Nick Holonyak (born 1928), U.S. – LED (Light Emitting Diode)
• Norman Holter (1914–1983), U.S. – Holter monitor
• Robert Hooke (1635–1703), UK – balance wheel, iris diaphragm, acoustic telephone
• Erna Schneider Hoover (born 1926), U.S. – computerized telephone switching system
• Grace Murray Hopper (1906–1992), U.S. – Compiler
• Frank Hornby (1863–1936), UK – invented Meccano
- Jimmy Hotz (born 1953), U.S. – Hotz MIDI Translator, Atari Hotz Box
- Royal Earl House (1814–1895), U.S. – first Printing telegraph
- Coenraad Johannes van Houten (1801–1887), Netherlands – cocoa powder, cacao butter, chocolate milk
- Elias Howe (1819–1867), U.S. – sewing machine
- David Edward Hughes (1831–1900), UK – printing telegraph
- Chuck Hull (born 1939), U.S. – 3D printer
- Troy Hurtubise (1963–2018), Canada – Trojan Ballistics Suit of Armor, Ursus suit, Firepaste, Angel Light
- Miller Reese Hutchison (1876–1944), U.S. – Klaxon, electric hearing aid
- Christiaan Huygens (1629–1695), Netherlands – pendulum clock
- Gavriil Ilizarov (1921–1992), Russia – Ilizarov apparatus, external fixation, distraction osteogenesis
- Mamoru Imura (born 1948), Japan – RFIQin (automatic cooking device)
- Daisuke Inoue (born 1940), Japan – Karaoke machine
- János Irinyi (1817–1895), Hungary – noiseless match
- Ub Iwerks (1901–1971), U.S. – Multiplane camera for animation
- Moritz von Jacobi (1801–1874), Germany/Russia – electrotyping, electric boat
- Rudolf Jaenisch (born 1942), Germany/U.S. – first Genetically modified mouse
- Karl Jatho (1873–1933), Germany – aeroplane
- Al-Jazari (1136–1206), Iraq – crank-driven and hydropowered saqiya chain pump, crank-driven screw and screwpump, elephant clock, weight-driven clock, weight-driven pump, reciprocating piston suction pump, geared and hydropowered water supply system, programmable humanoid robots, robotics, hand washing automata, flush mechanism, lamination, static balancing, paper model, sand casting, molding sand, intermittency, linkage
- Ibn Al-Jazzar (Algizar) (895–979), Tunisia – sexual dysfunction and erectile dysfunction treatment drugs
- Ányos Jedlik (1800–1898), Hungary – Jedlik dynamo
- Alec John Jeffreys (born 1950), United Kingdom – DNA profiling (forensics)
- Charles Francis Jenkins (1867–1934), U.S. – television and movie projector (Phantoscope)
• Steve Jobs (1955–2011), U.S. – Apple Macintosh computer, iPod, iPhone, iPad and other devices, software operating systems and applications.
• Amos Edward Joel Jr. (1918–2008) U.S. – electrical engineer, known for several contributions and over seventy patents related to telecommunications switching systems
• Carl Edvard Johansson (1864–1943), Sweden – Gauge blocks
• Johan Petter Johansson (1853–1943), Sweden – Pipe wrench and adjustable spanner
• Reynold B. Johnson (1906–1998), U.S. – Hard disk drive
• Philipp von Jolly (1809–1884), Germany – Jolly balance
• Scott A. Jones (born 1960), U.S. – created one of the most successful versions of voicemail as well as ChaCha Search, a human-assisted internet search engine
• Tom Parry Jones (1935–2013), United Kingdom – first electronic Breathalyzer
• Assen Jordanoff (1896–1967), Bulgaria – airbag
• Marc Jorgenson, Canada, engineer, inventor and musician
• Anatol Josepho (1894–1980), patented the first coin-operated photo booth called the "Photomat" in 1925.
• Marjorie Joyner (1896–1994), U.S. – Permanent wave machine
• Whitcomb Judson (1836–1909), U.S. – zipper
• Percy Lavon Julian (1899–1975), U.S. – chemical synthesis of medicinal drugs from plants
• Ma Jun (fl. 220–265), China – south-pointing chariot (see differential gear), mechanical puppet theater, chain pumps, improved silk looms
• Mikhail Kalashnikov (1919–2013), Russia – AK-47 and AK-74 assault rifles (the most produced ever)
• Bob Kahn (born 1938), together with Vint Cerf (born 1943), U.S. – Internet Protocol (TCP/IP)
• Dawon Kahng (1931–1992), South Korea, together with Simon Sze (born 1936), Taiwan/U.S. – Floating-gate MOSFET
• Dean Kamen (born 1951), U.S. – Invented the Segway HT scooter and the IBOT Mobility Device
• Heike Kamerlingh Onnes (1853–1926), Netherlands – liquid helium
• Nikolay Kamov (1902–1973), Russia – armored battle autogyro, Ka-series coaxial rotor helicopters
• Pyotr Kapitsa (1894–1984), Russia – first ultrastrong magnetic field creating techniques, basic low-temperature physics inventions
• Georgii Karpechenko (1899–1941), Russia – rabbage (the first ever non-sterile hybrid obtained through the crossbreeding)
• Jamshīd al-Kāshī (c. 1380–1429), Persia/Iran – plate of conjunctions, analog planetary computer
- Eugene Kaspersky (born 1965), Russia – Kaspersky Anti-Virus, Kaspersky Internet Security, Kaspersky Mobile Security anti-virus products
- Andrew Kay (1919–2014), U.S. – Digital voltmeter
- Adolphe Kégresse (1879–1943), France/Russia – Kégresse track (first half-track and first off-road vehicle with continuous track), dual-clutch transmission
- Carl D. Keith (1920–2008), together with John J. Mooney (c. 1928–), U.S. – three way catalytic converter
- Mstislav Keldysh (1911–1978), Latvia/Russia – co-developer of Sputnik 1 (the first artificial satellite) together with Korolyov and Tikhonravov
- John Harvey Kellogg (1852–1943), cornflake breakfasts
- Alexander Kemurdzhian (1921–2003), Russia – first space exploration rover (Lunokhod)
- Mary Kenner (1912–2006), U.S. – sanitary belt
- William Saville-Kent (1845–1908), UK/Australia – Pearl culture, see also Mikimoto Kōkichi
- Kerim Kerimov (1917–2003), Azerbaijan and Russia – co-developer of human spaceflight, space dock, space station
- Fazlur Khan (1929–1982), Bangladesh – structural systems for high-rise skyscrapers
- Yulii Khariton (1904–1996), Russia – chief designer of the Soviet atomic bomb, co-developer of the Tsar Bomba
- Anatoly Kharlampiyev (1906–1979), Russia – Sambo (martial art)
- Al-Khazini (fl.1115–1130), Persia/Iran – hydrostatic balance
- Konstantin Khrenov (1894–1984), Russia – underwater welding
- Abu-Mahmud Khojandi (c. 940–1000), Persia/Iran – astronomical sextant
- Muhammad ibn Musa al-Khwarizmi (Algoritmi) (c. 780–850), Persia/Iran – modern algebra, mural instrument, horary quadrant, Sine quadrant, shadow square
- Marcel Kiepach (1894–1915), Croatia – dynamo, maritime compass that indicates north regardless of the presence of iron or magnetic forces
- Erhard Kietz (1909–1982), Germany & U.S. – signal improvements for video transmissions
- Jack Kilby (1923–2005), U.S. – patented the first integrated circuit
- Al-Kindi (Alkindus) (801–873), Iraq/Yemen – unambiguously described the distillation of wine in the 9th century, cryptanalysis, frequency analysis
- Petrus Jacobus Kipp (1808–1864), The Netherlands – Kipp's apparatus (chemistry)
- Steve Kirsch (born 1956), U.S. – Optical mouse
- Fritz Klatte (1880–1934), Germany – vinyl chloride, forerunner to polyvinyl chloride
- Yves Klein (1928–1962), France – International Klein Blue
- Margaret E. Knight (1838–1914), U.S. – machine that completely constructs box-bottom brown paper bags
- Tom Knight (? – ), U.S. – BioBricks (synthetic biology)
- Ivan Knunyants (1906–1990), Armenia/Russia – capron, Nylon 6, polyamide-6
- Robert Koch (1843–1910), Germany – method for culturing bacteria on solid media
- Willem Johan Kolff (1911–2009), Netherlands – artificial kidney hemodialysis machine
- Rudolf Kompfner (1909–1977), U.S. – Traveling-wave tube
- Konstantin Konstantinov (1817 or 1819–1871), Russia – device for measuring flight speed of projectiles, ballistic rocket pendulum, launch pad, rocket-making machine
- Sergei Korolev (1907–1966), USSR – first successful intercontinental ballistic missile (R-7 Semyorka), R-7 rocket family, Sputniks (including the first Earth-orbiting artificial satellite), Vostok program (including the first human spaceflight)
- Nikolai Korotkov (1874–1920), Russian Empire – auscultatory technique for blood pressure measurement
- Semyon Korsakov (1787–1853), Russian Empire – punched card for information storage
- Mikhail Koshkin (1898–1940), Russia – T-34 medium tank, the best and most produced tank of World War II
- Ognjeslav Kostović (1851–1916), Serbia/Russia – arborite (high-strength plywood, an early plastic)
- Gleb Kotelnikov (1872–1944), Russia – knapsack parachute, drogue parachute
- Alfred Krupa (1915-1989), Yugoslavia - the modern wheeled suitcase, a glass-bottom boat, the skis for use in walking on water, a folding canvas catamaran
- Aleksey Krylov (1863–1945), Russia – gyroscopic damping of ships
- Ivan Kulibin (1735–1818), Russia – egg-shaped clock, candle searchlight, elevator using screw mechanisms, a self-rolling carriage featuring a flywheel, brake, gear box, and bearing, an early optical telegraph
- Shen Kuo (1031–1095), China – improved gnomon, armillary sphere, clepsydra, and sighting tube
Igor Kurchatov (1903–1960), Russia – first nuclear power plant, first nuclear reactors for submarines and surface ships


Raymond Kurzweil (born 1948), Optical character recognition; flatbed scanner

Ken Kutaragi (born 1950), Japan – PlayStation

Stephanie Kwolek (1923–2014), U.S. – Kevlar

John Howard Kyan (1774–1850), Ireland – The process of Kyanization used for wood preservation

Dmitry Lachinov (1842–1902), Russia – mercury pump, economizer for electricity consumption, electrical insulation tester, optical dynamometer, photometer, electrolyser

René Laennec (1781–1826), France – stethoscope

Georges Lakhovsky (1869–1942), Russia/U.S. – Multiple Wave Oscillator

Hedy Lamarr (1913–2000), Austria and U.S. – Spread spectrum radio


Samuel P. Langley (1834–1906), U.S. – bolometer

Alexander Nikolayevich Lodygin (1847–1923), Russia – incandescent lamp

Irving Langmuir (1851–1957), U.S. – gas filled incandescent light bulb, hydrogen welding


Lewis Latimer (1848–1928), U.S. – improved carbon-filament light bulb

Gustav de Laval (1845–1913), Sweden – invented the milk separator and the milking machine

Semyon Lavochkin (1900–1960), Russia – La-series aircraft, first operational surface-to-air missile S-25 Berkut

John Bennet Lawes (1814–1900), UK – superphosphate or chemical fertilizer

Ernest Orlando Lawrence (1901–1958), U.S. – Cyclotron

Nikolai Lebedenko, Russia – Tsar Tank, the largest armored vehicle in history

Sergei Lebedev (1874–1934), Russia – commercially viable synthetic rubber

William Lee (1563–1614), UK – Stocking frame knitting machine

Edward Leedskalnin (1887–1951), U.S. – construction techniques used to single-handedly lift massive coral blocks in the creation of his Coral Castle

Antoni van Leeuwenhoek (1632–1723), The Netherlands – development of the microscope
• Jerome H. Lemelson (1923–1997), U.S. – Inventions in the fields in which he patented make possible, wholly or in part, innovations like automated warehouses, industrial robots, cordless telephones, fax machines, videocassette recorders, camcorders, and the magnetic tape drive used in Sony's Walkman tape players.

• Jean-Joseph Etienne Lenoir (1822–1900), Belgium – internal combustion engine, motorboat

• Giacomo da Lentini (13th Century), Italy – Sonnet

• R. G. LeTourneau (1888–1969), U.S. – electric wheel, motor scraper, mobile oil drilling platform, bulldozer, cable control unit for scrapers

• Rasmus Lerdorf (born 1968), Greenland/Canada – PHP (programming language)

• Willard Frank Libby (1908–1980), U.S. – radiocarbon dating

• Justus von Liebig (1803–1873), Germany – nitrogen-based fertilizer

• Hon Lik (born 1951), Chinese. electronic cigarette

• Otto Lilienthal (1848–1896), Germany – hang glider

• Lin Yutang (1895–1976), China/U.S. – Chinese language typewriter

• Charles Lindbergh (1902–1974), U.S. – organ perfusion pump

• Frans Wilhelm Lindqvist (1862–1931), Sweden – Kerosene stove operated by compressed air

• Carl Linnaeus (1707–1778), Sweden – formal Binomial nomenclature for living organisms, Horologium Florae

• Hans Lippershey (1570–1619), The Netherlands – associated with the appearance of the telescope

• Jonas Ferdinand Gabriel Lippmann (1845–1921), France – Lippmann plate, Integral imaging, Lippmann electrometer

• Lisitsyn brothers, Ivan Fyodorovich and Nazar Fyodorovich, Russia – samovar (the first documented makers)

• William Howard Livens (1889–1964), UK – chemical warfare – Livens Projector

• Eduard Locher (1840–1910), Switzerland – Locher rack railway system

• Fredrik Ljungström (1875–1964) and Birger Ljungström (1872–1948), Sweden – Ljungström turbine, Ljungström air preheater, Ljungström method

• Alexander Lodygin (1847–1923), Russia – electrical filament, incandescent light bulb with tungsten filament

• Mikhail Lomonosov (1711–1765), Russia – night vision telescope, off-axis reflecting telescope, coaxial rotor, re-invented smalt

• Yury Lomonosov (1876–1952), Russia/United Kingdom – first successful mainline diesel locomotive
- Aleksandr Loran (1849 – after 1911), Russia – fire fighting foam, foam extinguisher
- Oleg Losev (1903–1942), Russia – light-emitting diode, crystadine
- Antoine Louis (1723–1792), France – Guillotine
- Archibald Low (1882–1956), Britain – Pioneer of radio guidance systems
- Ed Lowe (1920–1995), U.S. – Cat litter
- Gleb Lozino-Lozinskiy (1909–2001), Russia – Buran (spacecraft), Spiral project
- Ignacy Łukasiewicz (1822–1882), Poland – Kerosene lamp
- Cai Lun, 蔡倫 (50–121 AD), China – paper
- Giovanni Luppis or Ivan Vukić (1813–1875), Austrian Empire (ethnical Croatian, from Rijeka) – self-propelled torpedo
- Richard F. Lyon (born 1952), U.S. – Optical mouse
- Arkhip Lyulka (1908–1984), Russia – first double jet turbofan engine, other Soviet aircraft engines
- Charles Macintosh (1766–1843), Scotland – waterproof raincoat, life vest
- Ahmed Majan (born 1963), UAE – instrumented racehorse saddle and others
- Aleksandr Makarov (?–), Russia/Germany – Orbitrap mass spectrometer
- Stepan Makarov (1849–1904), Russia – Icebreaker Yermak, the first true icebreaker able to ride over and crush pack ice
- Victor Makeev (1924–1985), Russia – first submarine-launched ballistic missile
- Nestor Makhno (1888–1934), Ukraine/Russia – tachanka
- Dmitri Dmitrievich Maksutov (1896–1964), Russia – Maksutov telescope
- Annie Malone (1869–1957), U.S. – Cosmetics for African American women
- Sergey Malyutin (1859–1937), Russia – designed the first matryoshka doll (together with Vasily Zvyozdochkin)
- Al-Ma'mun (786–833), Iraq – singing bird automata, terrestrial globe
- Boris Mamyrin (1919–2007), Russia – reflectron (ion mirror)
- George William Manby (1765–1854), UK – Fire extinguisher
- Joy Mangano (born 1956), U.S. – household appliances
- Charles Mantoux (1877–1947), France – Mantoux test (tuberculosis)
- Guglielmo Marconi (1874–1937), Italy – radio telegraphy
- Gheorghe Marinescu (1863–1938), Romania – the first science films in the world in the neurology clinic in Bucharest (1898–1901)
- Sylvester Marsh (1803–1884), U.S. – Marsh rack railway system
- Konosuke Matsushita (1894–1989), Japan – battery-powered Bicycle lighting
- Taqi al-Din Muhammad ibn Ma'ruf (1526–1585), Syria/Egypt/Turkey – steam turbine, six-cylinder 'Monobloc' suction pump, framed sextant
- John Landis Mason (1826–1902), U.S. – Mason jars
- Fujio Masuoka (born 1943), Japan – Flash memory
- John W. Mauchly (1907–1980), U.S. – ENIAC – the first general purpose programmable digital computer
- Henry Maudslay (1771–1831), UK – screw-cutting lathe, bench micrometer
- Hiram Maxim (1840–1916), U.S. born, UK – First self-powered machine gun
- James Clerk Maxwell (1831–1879) and Thomas Sutton, Scotland – color photography
- Stanley Mazor (born 1941), U.S. – microprocessor
- John Loudon McAdam (1756–1836), Scotland – improved "macadam" road surface
- Elijah McCoy (1843–1929), Canada – Displacement lubricator
- Nicholas McKay Sr. (1920–2014), U.S. – Lint roller
- James McLurkin (born 1972), U.S. – Ant robotics (robotics)
- Ilya Ilyich Mechnikov (1845–1916), Russia – probiotics
- Hippolyte Mège-Mouriès (1817–1880), France – margarine
- Mordecai Meirowitz (born c. 1925), Roumania / Israel – Mastermind (board game)
- Dmitri Mendeleev (1834–1907), Russia – Periodic table, pycnometer, pyrocollodion
- George de Mestral (1907–1990), Switzerland – Velcro
- Robert Metcalfe (born 1946), U.S. – Ethernet
- Antonio Meucci (1808–1889), Italy/U.S. – various early telephones, a hygrometer, a milk test
- Édouard Michelin (1859–1940), France – pneumatic tire
- Anthony Michell (1870–1959), Australia – tilting pad thrust bearing, crankless engine
- Artem Mikoyan (1905–1970), Armenia/Russia – MiG-series fighter aircraft, including world's most produced jet aircraft MiG-15 and most produced supersonic aircraft MiG-21 (together with Mikhail Gurevich)
- Alexander Mikulin (1895–1985), Russia – Mikulin AM-34 and other Soviet aircraft engines, co-developer of the Tsar Tank
- Mikhail Mil (1909–1970), Russia – Mi-series helicopter aircraft, including Mil Mi-8 (the world's most-produced helicopter) and Mil Mi-12 (the world's largest helicopter)
- David L. Mills (born 1938), U.S. – Fuzzball router, Network Time Protocol
- Marvin Minsky (1927–2016), U.S. – Confocal microscopy
- Tokushichi Mishima (1893–1975), Japan – MKM magnetic steel
- Pavel Molchanov (1893–1941), Russia – Radiosonde
- Jules Montenier (1895–1962), U.S. – Anti-perspirant deodorant
- Montgolfier brothers (1740–1810) and (1745–1799), France – hot air balloon
- John J. Montgomery (1858–1911), U.S. – heavier-than-air gliders
- Narcis Monturiol i Estarriol (1819–1885), Spain – steam powered submarine
- Robert Moog (1934–2005), U.S. – the Moog synthesizer
- John J. Mooney (born 1929), together with Carl D. Keith (1920–2008), U.S. – three way catalytic converter
- Roland Moreno (1945–2012), France – inventor of the smart card
- Samuel Morey (1762–1843), U.S. – internal combustion engine
- Garrett A. Morgan (1877–1963), U.S. – inventor of the smoke hood
- Alexander Morozov (1904–1979), Russia – T-54/55 (the most produced tank in history), co-developer of T-34
- Walter Frederick Morrison (1920–2010), U.S. – Flying disc
- William Morrison (dentist) (1860–1926), U.S. – Cotton candy machine
- Samuel Morse (1791–1872), U.S. – early Morse code, see also Morse Code controversy
- Sergei Ivanovich Mosin (1849–1902), Russia – Mosin–Nagant rifle
- Motorins, Ivan Feodorovich (1660s–1735) and his son Mikhail Ivanovich (?,–1750), Russia – Tsar Bell
- Vera Mukhina (1889–1953), Russia – welded sculpture
- Kary Mullis (born 1944), U.S. – PCR
- Fe del Mundo (1911–2011), The Philippines – medical incubator made out of bamboo for use in rural communities without electrical power
- Colin Murdoch (1929–2008), New Zealand – Tranquillizer gun, disposable hypodermic syringe
- William Murdoch (1754–1839), Scotland – Gas lighting
- Jozef Murgas (1864–1929), Slovakia – inventor of the wireless telegraph (forerunner of the radio)
• Evgeny Murzin (1914–1970), Russia – ANS synthesizer
• Banū Mūsā brothers, Muhammad (c. 800–873), Ahmad (803–873), Al-Hasan (810–873), Iraq – mechanical trick devices, hurricane lamp, self-trimming and self-feeding lamp, gas mask, clamshell grab, fail-safe system, mechanical musical instrument, automatic flute player, programmable machine
• Elon Musk (born 1971)
• Pieter van Musschenbroek (1692–1761), Netherlands – Leyden jar, pyrometer
• Walton Musser (1909–1998), U.S. – Harmonic drive gear
• Eadweard Muybridge (1830–1904), UK – motion picture
• Georgi Nadjakov (1896–1981), Bulgaria – wikt:photoelectret
• Alexander Nadiradze (1914–1987), Georgia/Russia – first mobile ICBM (RT-21 Temp 2S), first reliable mobile ICBM (RT-2PM Topol)
• Nagai Nagayoshi (1844–1929), Japan – Methamphetamine
• James Naismith (1861–1939), Canadian born, U.S. – invented basketball and American football helmet
• Yoshiro Nakamatsu (born 1928), Japan – "PyonPyon" spring shoes, digital watch, CinemaScope, armchair "Cerebrex", sauce pump, taxicab meter
• Shuji Nakamura (born 1954), Japan – Blue laser
• John Napier (1550–1617), Scotland – logarithms
• Andrey Nartov (1683–1756), Russia – first lathe with a mechanic cutting tool-supporting carriage and a set of gears, fast-fire battery on a rotating disc, screw mechanism for changing the artillery fire angle, gauge-boring lathe for cannon-making, early telescopic sight
• James Nasmyth (1808–1890), Scotland – steam hammer
• Giulio Natta (1903–1979), together with Karl Ziegler (1898–1973), Italy/Germany – Ziegler–Natta catalyst
• William Neade (fl.1624–1637), England – weapon combining a longbow and a pike
• Nebuchadrezzar II (634–562 BC), Iraq (Mesopotamia) – screw, screwpump
• Erwin Neher (born 1944), together with Bert Sakmann (1942–), Germany – Patch clamp technique
• Ted Nelson (born 1937), U.S. – Hypertext, Hypermedia
• Sergey Nepobedimiy (1921–2014), Russia – first supersonic anti-tank guided missile Sturm, other Soviet rocket weaponry
• Karl Nessler (1872–1951), Germany/U.S. – Permanent wave machine, artificial eyebrows
• Bernard de Neumann (born 1943), United Kingdom – massively parallel self-configuring multi-processor
• John von Neumann (1903–1957), Hungary – Von Neumann computer architecture
• Isaac Newton (1642–1727), UK – reflecting telescope (which reduces chromatic aberration)
• Miguel Nicolelis (born 1961), Brazil – Brain-machine interfaces
• Joseph Nicéphore Niépce (1765–1833), France – photography
• Nikolai Nikitin (1907–1973), Russia – prestressed concrete with wire ropes structure (Ostankino Tower), Nikitin-Travush 4000 project (precursor to X-Seed 4000)
• Paul Gottlieb Nipkow (1860–1940), Germany – Nipkow disk
• Jun-ichi Nishizawa (born 1926), Japan – Optical communication system, SIT/SITH (Static Induction Transistor/Thyristor), Laser diode, PIN diode
• Alfred Nobel (1833–1896), Sweden – dynamite
• Ludvig Nobel (1831–1888), Sweden/Russia – first successful oil tanker
• Emmy Noether (1882–1935), Germany, groundbreaking contributions to abstract algebra and theoretical physics; Noether's Theorem
• Jean-Antoine Nollet (1700–1770), France – Electroscope
• Wilhelm Normann (1870–1939), Germany – Hydrogenation of fats
• Carl Richard Nyberg (1858–1939), Sweden – the blowtorch
• Aaron D. O'Connell (born 1981), U.S. – first Quantum machine
• Joseph John O'Connell (1861–1959), U.S. – number of inventions relating to telephony and electrical engineering
• Theophil Wilgodt Odhner (1845–1903), Sweden/Russia – the Odhner Arithmometer, a mechanical calculator
• Paul Offit (born 1951), United States, along with Fred Clark and Stanley Plotkin, invented a pentavalent Rotavirus vaccine
• Jarkko Oikarinen (born 1967), Finland – Internet Relay Chat (IRC)
• Katsuhiko Okamoto (?–), Japan – Okamoto Cubes = modifications of Rubik's Cube
• Ransom Eli Olds (1864–1950), United States – Assembly line
• Lucien Olivier (1838–1883), Belgium or France / Russia – Russian salad (Olivier salad)
• J. Robert Oppenheimer (1904–1967), United States – Atomic bomb
• Hugh Orr (1715–1798), U.S. – machine for cleaning flax seed
• Hans Christian Ørsted (1777–1851), Denmark – electromagnetism, aluminium
• Elisha Otis (1811–1861), U.S. – safety system for elevators
- William Oughtred (1575–1660), UK – slide rule
- Arogyaswami Paulraj (born 1944), India/U.S. – MIMO
- Antonio Pacinotti (1841–1912), Italy – Pacinotti dynamo
- Salvatore Pais (born 1967), Romania/U.S. – an electromagnetic field generator to deflect asteroids away from the Earth, an inertial mass reduction device, a room-temperature superconductor, a gravitational wave generator, and a compact fusion reactor
- Alexey Pajitnov (born 1956), Russia/U.S. – Tetris
- Julio Palmaz (born 1945), Argentina – balloon-expandable, stent
- Helge Palmarantz (1842–1880), Sweden – the multi-barrel, lever-actuated, machine gun
- Daniel David Palmer (1845–1913), Canada – chiropractic
- Luigi Palmieri (1807–1896), Italy – seismometer
- Frank Pantridge (1916–2004), Ireland – Portable defibrillator
- Georgios Papanikolaou (1883–1962), Greece / U.S. – Papanicolaou stain, Pap test = Pap smear
- Philip M. Parker (born 1960), U.S. – computer automated book authoring
- Thomas Parker (1843–1915), England – electric car
- Alexander Parkes (1831–1890), UK – celluloid
- Forrest Parry (1921–2005), U.S. – Magnetic stripe card
- Charles Algernon Parsons (1854–1931), British – steam turbine
- Spede Pasanen (1930–2001), Finland – ski jumping sling, boat ski
- Blaise Pascal (1623–1662), France – Pascal’s calculator
- Gustaf Erik Pasch (1788–1862), Sweden – safety match
- Dimitar Paskov (1914–1986), Bulgaria – Galantamine
- C. Kumar N. Patel (born 1938), India/U.S. – Carbon dioxide laser
- Les Paul (1915–2009), U.S. – multitrack recording
- Andreas Pavel (born 1945), Brazil – audio devices
- Ivan Pavlov (1849–1936), Russia – classical conditioning
- Floyd Paxton (1918–1975), U.S. – Bread clip
- John Pemberton (1831–1888), U.S. – Coca-Cola
• Slavoljub Eduard Penkala (1871–1922), Croatia – mechanical pencil
• William Henry Perkin (1838–1907), United Kingdom – first synthetic organic chemical dye Mauveine
• Henry Perky (1843–1906), U.S. – shredded wheat
• Alfred Perot (1863–1925), together with Charles Fabry (1867–1945), France – Fabry–Pérot interferometer (physics)
• Stephen Perry, UK (fl. 19th century) – rubber band
• Aurel Persu (1890–1977), Romania – first aerodynamic car, aluminum body with wheels included under the body, 1922
• Vladimir Petlyakov (1891–1942), Russia – heavy bomber
• Julius Richard Petri (1852–1921), Germany – Petri dish
• Peter Petroff (1919–2004), Bulgaria – digital wrist watch, heart monitor, weather instruments
• Fritz Pfleumer (1881–1945), Germany – magnetic tape
• Auguste Piccard (1884–1962), Switzerland – Bathyscaphe
• Gregory Goodwin Pincus (1903–1967), together with Min Chueh Chang (1908–1991), U.S./China – Combined oral contraceptive pill
• Nikolay Ivanovich Pirogov (1810–1881), Russia – early use of ether as anaesthetic, first anaesthesia in a field operation, various kinds of surgical operations
• Fyodor Pirotsky (1845–1898), Russia – electric tram
• Arthur Pitney (1871–1933), United States – postage meter
• Hippolyte Pixii (1808–1835), France – Pixii dynamo
• Joseph Plateau (1801–1883), Belgium – phenakistiscope (stroboscope)
• Baltzar von Platen (1898–1984), Sweden – gas absorption refrigerator
• James Leonard Plimpton (1828–1911), U.S. – roller skates
• Ivan Plotnikov (1902–1995), Russia – kirza leather
• Roy Plunkett (1910–1994), United States – Teflon
• Petrache Poenaru (1799–1875), Romania – fountain pen
• Christopher Polhem (1661–1751), Sweden – Padlock
• Nikolai Polikarpov (1892–1944), Russia – Po-series aircraft, including Polikarpov Po-2 Kukuruznik (world's most produced biplane)
• Eugene Polley (1915–2012), United States – wireless remote control (with Robert Adler)
• Ivan Polzunov (1728–1766), Russia – first two-cylinder steam engine
• Mikhail Pomortsev (1851–1916), Russia – nephoscope
• Olivia Poole (1889–1975), U.S. – the Jolly Jumper baby harness
• Alexander Popov (1859–1906), Russia – radio pioneer, created a radio receiver that worked as a lightning detector
• Nikolay Popov (1931–2008), Russia – first fully gas turbine main battle tank (T-80)
• Josef Popper (1838–1921), Austria – discovered the transmission of power by electricity.
• Aleksandr Porokhovschikov (1892–1941), Russia – Vezdekhod (the first prototype tank, or tankette, and the first caterpillar amphibious ATV)
• Ignazio Porro (1801–1875), Italy – Porro prism, strip camera
• Valdemar Poulsen (1869–1942), Denmark – magnetic wire recorder, arc converter
• Joseph Priestley (1733–1804), UK – soda water
• Robert Taylor Pritchett (1828–1907), UK – Pritchett bullet
• Alexander Procofieff de Seversky (1894–1974), Russia/United States of America – first gyroscopically stabilized bombsight, ionocraft, also developed air-to-air refueling
• Alexander Prokhorov (1916–2002), Russia – co-inventor of laser and maser
• Petro Prokopovych (1775–1850), Russian Empire – early beehive frame, queen excluder and other beekeeping novelties
• Sergey Prokudin-Gorsky (1863–1944), Russia/France – early colour photography method based on three colour channels, also colour film slides and colour motion pictures
• Mark Publicover (born 1958), U.S. – First affordable trampoline safety net enclosure
• George Pullman (1831–1897), U.S. – Pullman sleep wagon
• Michael I. Pupin (1858–1935), Serbia – pupinization (loading coils), tunable oscillator
• Tivadar Puskás (1844–1893), Hungary – telephone exchange

• Calvin Quate (born 1923), with Gerd Binnig (born 1947), and with Christoph Gerber (?–), U.S./Germany/Switzerland – Atomic force microscope
• Adolphe Quetelet (1796–1874), France/Belgium – Body mass index (BMI)
• Jacob Rabinow (1910–1999), U.S. – Magnetic particle clutch, various Phonograph-related patents
• John Goffe Rand (1801–1873), U.S. – Tube (container)
• Robert Ransome (1753–1830), England – improvement to the plough
• Muhammad ibn Zakariya Rāzi (Rhazes) (865–965), Persia/Iran – distillation and extraction methods, sulfuric acid and hydrochloric acid, soap kerosene, kerosene lamp, chemotherapy, sodium hydroxide
• Alec Reeves (1902–1971), UK – Pulse-code modulation
• Karl von Reichenbach (1788–1869), Germany – paraffin, creosote oil, phenol
• Tadeus Reichstein (1897–1996), Poland/Switzerland – Reichstein process (industrial vitamin C synthesis)
• Ira Remsen (1846–1927), U.S. – saccharin
• Ralf Reski (born 1958), Germany – Moss bioreactor 1998
• Josef Ressel (1793–1857), Czechoslovakia – ship propeller
• William Reynolds (1758–1803), England – canal inclined plane
• Ri Sung-gi (1905–1996), North Korea – Vinylon
• Charles Francis Richter (1900–1985), U.S. – Richter magnitude scale
• Adolph Rickenbacker (1886–1976), Switzerland – Electric guitar
• Hyman George Rickover (1900–1986), U.S. – Nuclear submarine
• Niklaus Riggenbach (1817–1899), Switzerland – Riggenbach rack railway system, Counter-pressure brake
• Dennis Ritchie (1941–2011), U.S. – C (programming language)
• Gilles de Roberval (1602–1675), France – Roberval balance
• John Roebuck (1718–1794) UK – lead chamber process for sulfuric acid synthesis
• Francis Rogallo (1912–2009), U.S. – Rogallo wing
• Heinrich Rohrer (1933–2013), together with Gerd Binnig (1947–), Switzerland/Germany – Scanning tunneling microscope
• Peter I the Great (Pyotr Alexeyevich Romanov), Tsar and Emperor of Russia (1672–1725), Russia – decimal currency, yacht club, sounding line with separating plummet (sounding weight probe)
• Wilhelm Conrad Röntgen (1845–1923), Germany – the X-ray machine
• Ida Rosenthal (1886–1973), Belarus/Russia/United States – Bra (Maidenform), the standard of cup sizes, nursing bra, full-figured bra, the first seamed uplift bra (all with her husband William)
• Sidney Rosenthal (1907–1979), U.S. – Magic Marker
• Eugene Roshal (born 1972), Russia – FAR file manager, RAR file format, WinRAR file archiver
• Boris Rosing (1869–1933), Russia – CRT television (first television system using CRT on the receiving side)
• Guido van Rossum (born 1956), The Netherlands – Python (programming language)
• Subrata Roy (scientist) (born 1962), India, U.S. – Wingless Electromagnetic Air Vehicle, Serpentine geometry plasma actuator, micro-scale actuators
• Jean-François Pilâtre de Rozier (1754–1785), France – Rozière balloon
• Ernő Rubik (born 1944), Hungary – Rubik's Cube, Rubik's Magic and Rubik's Clock
• Ernst Ruska (1906–1988), Germany – electron microscope
• Albert Bruce Sabin (1906–1993), U.S. – oral Polio vaccine
• Alexander Sablukov (1783–1857), Russia – centrifugal fan
• Şerafeddin Sabuncuoğlu (1385–1468), Turkey – illustrated surgical atlas
• Gilles Saint-Hilaire (born 1948), Canada – Quasiturbine, Qurbine
• Andrei Sakharov (1921–1989), Russia – invented explosively pumped flux compression generator, co-developed the Tsar Bomb and tokamak
• Robert Salmon (1763–1821), England – agricultural implements
• Franz San Galli (1824–1908), Poland/Russia (Italian and German descent) – radiator, central heating
• Frederick Sanger (1918–2013), U.S. – Sanger sequencing (= DNA sequencing)
• Yoshiyuki Sankai (born c. 1957), Japan – Robotic exoskeleton for motion support (medicine)
• Alberto Santos-Dumont (1873–1932), Brazil – non-rigid airship and airplane
• Arthur William Savage (1857–1938) – radial tires, gun magazines, Savage Model 99 lever action rifle
• Thomas Savery (1650–1715), UK – steam engine
• Adolphe Sax (1814–1894), Belgium – saxophone
• Vincent Joseph Schaefer (1906–1993), U.S. – Cloud seeding by dry ice
• Bela Schick (1877–1967), Hungary – diphtheria test
• Wilhelm Schickard (1592–1635), Germany – mechanical calculator
• Hugo Schiff (1834–1915), Germany – Schiff test (histology)
• Pavel Schilling (1786–1837), Estonia/Russia – first electromagnetic telegraph, mine with an electric fuse
• Gilmore Schjeldahl (1912–2002), U.S. – Airsickness bag
• Hubert Schlafly (1919–2011), U.S. – Teleprompter = Autocue
• Wilhelm Schlenk (1879–1943), Germany – Schlenk flask (chemistry)
• Bernhard Schmidt (1879–1935), Estonia/Germany – Schmidt camera
• Friedrich Schmiedl (1902–1994), Austria – rocket mail
• Christian Schnabel (1878–1936), German – simplistic food cutlery
• Kees A. Schouhamer Immink (born 1946), Netherlands – Major contributor to development of Compact Disc
• August Schrader (1807–1894), U.S. – Schrader valve for Pneumatic tire
• David Schwarz (1852–1897), Croatia – rigid ship, later called Zeppelin
• Raymond Scott (1908–1994), U.S. – inventor and developer of electronic music technology
• Girolamo Segato (1792–1836), Italy – artificial petrifaction of human cadavers
• Marc Seguin (1786–1875), France – wire-cable suspension bridge
• Hanaoka Seishū (1760–1835), Japan – General anaesthetic
• Ted Selker (inv. 1987), U.S. – Pointing stick
• Sennacherib (705–681 BC), Iraq (Mesopotamia) – screw pump
• Léon Serpollet (1858–1907), France – Flash boiler, Gardner-Serpollet steam car
• Iwan Serrurier (1878–1953), Netherlands/U.S. – inventor of the Moviola for film editing
• Mark Serrurier (1904–1988), U.S. – Serrurier truss for Optical telescopes
• Gerhard Sessler (born 1931), Germany – foil electret microphone, silicon microphone
• Guy Severin (1926–2008), Russia – extra-vehicular activity supporting system
• Ed Seymour (inv. c. 1949), U.S. – Aerosol paint
• Leonty Shamshurenkov (1687–1758), Russia – first self-propelling carriage (a precursor to both bicycle and automobile), projects of an original odometer and self-propelling sledge
• Ibn al-Shatir (1304–1375), Syria – "jewel box" device which combined a compass with a universal sundial
• Bi Sheng (Chinese: 毕昇) (c. 990–1051), China – clay movable type printing
• Patsy O’Connell Sherman (1930—2008), U.S. — Scotchgard
• Murasaki Shikibu (c. 973–1025), Japan – psychological novel
• Pyotr Shilovsky (1871–1957), Russia/United Kingdom – gyrocar
• Masatoshi Shima (born 1943), Japan – microprocessor
• Fathullah Shirazi (c. 1582), Mughal India – early volley gun
• Joseph Shivers (1920–2014), U.S. – Spandex
- Henry Shrapnel (1761–1842), UK – Shrapnel shell ammunition
- Vladimir Shukhov (1853–1939), Russia – thermal cracking (Shukhov cracking process), thin-shell structure, tensile structure, hyperboloid structure, gridshell, oil pipeline, cylindric oil depot
- Sheikh Muszaphar Shukor (born 1972), Malaysia – cell growth in outer space, crystallization of proteins and microbes in space
- Augustus Siebe (1788–1872), Germany/UK – Inventor of the standard diving dress
- Sir William Siemens (1823–1883), Germany – regenerative furnace
- Werner von Siemens (1816–1892), Germany – electric elevator, Electromote (= first trolleybus), an early Dynamo
- Al-Sijzi (c. 945–1020), Persia/Iran – heliocentric astrolabe
- Igor Sikorsky (1889–1972), Russia/U.S. – first four-engine fixed-wing aircraft (Rusksy Vityaz), first airliner and purpose-designed bomber (Ilya Muromets), helicopter, Sikorsky-series helicopters
- Kia Silverbrook (born 1958), Australia – Memjet printer, world's most prolific inventor
- Vladimir Simonov (born 1935), Russia – APS Underwater Assault Rifle, SPP-1 underwater pistol
- Charles Simonyi (born 1948), Hungary – Hungarian notation
- Ibn Sina (Avicenna) (980–1037), Persia/Iran – steam distillation, essential oil, pharmacopoeia, clinical pharmacology, clinical trial, randomized controlled trial, quarantine, cancer surgery, cancer therapy, pharmacotherapy, phytotherapy, Hindiba, Taxus baccata L, calcium channel blocker
- Isaac Singer (1811–1875), U.S. – sewing machine
- B. F. Skinner (1904–1990), U.S. – Operant conditioning chamber
- Nikolay Slavyanov (1854–1897), Russia – shielded metal arc welding
- Alexander Smakula (1900–1983), Ukraine/Russia/U.S. – anti-reflective coating
- Oliver Smithies (1925–2017), together with Sir Martin John Evans (born 1941), and Mario Ramberg Capecchi (born 1937), U.S. – Knockout mouse, Gene targeting
- Yefim Smolin, Russia – table-glass (stakan granyonyi)
- Friedrich Soennecken (1848–1919), Germany – Ring binder, Hole punch
- Su Song (1020–1101), China – first chain drive
- Marin Soljačić (born 1974), Croatia – Resonant inductive coupling
- Edwin Southern (born 1938), U.S. – Southern blot (molecular biology)
- Alfred P. Southwick (1826–1898), U.S. – Electric chair
• Igor Spassky (born 1926), Russia – Sea Launch platform
• Percy Spencer (1894–1970), U.S. – microwave oven
• Elmer Ambrose Sperry (1860–1930), U.S. – gyroscope-guided automatic pilot
• Lyman Spitzer (1914–1997), U.S. – Stellarator (physics)
• Bhargav Sri Prakash (born 1977), India/U.S. – Learnification platform at FriendsLearn, Virtual Reality System, electromagnetic collision avoidance system, OBD based in-vehicle powertrain performance measurement, rate based driver controls for drive by wire systems
• Ladislas Starevich (1882–1965), Russia/France – puppet animation, live-action/animated film
• Gary Starkweather (1938–2019), U.S. – laser printer, color management
• Boris Stechkin (1891–1969), Russia – co-developer of Sikorsky Ilya Muromets and Tsar Tank, developer of Soviet heat and aircraft engines
• George Stephenson (1781–1848), UK – steam railway
• Simon Stevin (1548–1620), Netherlands – land yacht
• Andreas Stihl (1896–1973), Switzerland/Germany – Electric chain saw
• Reverend Dr Robert Stirling (1790–1878), Scotland – Stirling engine
• Aurel Stodola (1859–1942), Slovakia – gas turbines
• Aleksandr Stoletov (1839–1896), Russia – first solar cell based on the outer photoelectric effect
• Levi Strauss (1829–1902), U.S. – blue jeans
• John Stringfellow (1799–1883), UK – aerial steam carriage
• Bjarne Stroustrup (born 1950), Denmark – C++ (programming language)
• Almon Strowger (1839–1902), U.S. – automatic telephone exchange
• Emil Strub (1858–1909), Switzerland – Strub rack railway system
• Abd al-Rahman al-Sufi (Azophi) (903–986), Persia/Iran – timekeeping astrolabe, navigational astrolabe, surveying astrolabe
• Kyota Sugimoto (1882–1972), Japan – Japanese language typewriter
• Mutsuo Sugiura (1918–1986), Japan – Esophagogastroduodenoscope
• Pavel Sukhoi (1895–1975), Russia – Su-series fighter aircraft
• Simon Sunatori (born 1959), Canada – inventor of MagneScribe and Magic Spicer
• Sushruta (600 BC), Vedic India – inventor of Plastic Surgery, Cataract Surgery, Rhinoplasty
• Theodor Svedberg (1884–1971), Sweden – Analytical ultracentrifuge
• Joseph Swan (1828–1914), UK – Incandescent light bulb
Robert Swanson (1905–1994), Canada – Invented and developed the first multi-chime air horn for use with diesel locomotives

Remi Swierczek (born 1958), Poland – Inventor of Music Identification System and the Mico Changer (coin hopper and dispenser used in casinos)

Andrei Sychra (c.1773/76–1850), Lithuania/Russia, Czech descent – Russian seven-string guitar

Walter Sylvester (1867–1944), UK – the "Sylvester", for safely removing pit props

Vladimir Syromyatnikov (1933–2006), Russia – Androgynous Peripheral Attach System and other spacecraft docking mechanisms

Simon Sze (born 1936), Taiwan/U.S., together with Dawon Kahng (1931–1992), South Korea – Floating-gate MOSFET

Leo Szilárd (1898–1964), Hungary/U.S. – Co-developed the atomic bomb, patented the nuclear reactor, catalyst of the Manhattan Project

Muhammad Salih Tahtawi (fl.1659–1660), Mughal India – seamless globe and celestial globe

Gyula Takátsy (1914–1980), Hungary – first Microtiter plate

Esther Takeuchi (born 1953) – holds more than 150 US-patents, the largest number for any woman in the United States

Igor Tamm (1895–1971), Russia – co-developer of tokamak

Ching W. Tang (born 1947), Hong Kong/U.S., together with Steven Van Slyke, U.S. – OLED

Mardi bin Ali al-Tarsusi (c. 1187), Middle East – counterweight trebuchet, mangonel

Gustav Tauschek (1899–1945), Austria – Drum memory

Kenyon Taylor (inv. 1961), U.S. – Flip-disc display

Bernard Tellegen (1900–1990), Netherlands – pentode

Edward Teller (1908–2003), Hungary – hydrogen bomb

Eli Terry (1772–1852)

Nikola Tesla (1856–1943), Croatia/Serbia – induction motor, high-voltage / high-frequency power experiments, the transmission of electrical power

Léon Theremin (1896–1993), Russia – theremin, interlace, burglar alarm, terpsitone, Rhythmicon (first drum machine), The Thing (listening device)

Charles Xavier Thomas de Colmar (1785–1870), France – Arithmometer

Elihu Thomson (1853–1937), UK, U.S. – Prolific inventor, Arc lamp and many others

William Thomson, 1st Baron Kelvin (1824–1907), United Kingdom – Kelvin absolute temperature scale
• Eric Tigerstedt (1887–1925), Finland – Sound-on-film, triode vacuum tube
• Kalman Tihanyi (1897–1947), Hungary – co-inventor of cathode ray tube and iconoscope
• Mikhail Tikhonravov (1900–1974), Russia – co-developer of Sputnik 1 (the first artificial satellite) together with Korolyov and Keldysh, designer of further Sputniks
• Gavriil Adrianovich Tikhov (1875–1960), Russia – feathering spectrograph
• Benjamin Chew Tilghman (1821–1897), U.S. – sandblasting
• Fedor Tokarev (1871–1968), Russia – TT-33 semiautomatic handgun and SVT-40 self-loading rifle
• Ray Tomlinson (inv. 1971), U.S. – First inter-computer email
• Evangelista Torricelli (1608–1647), Italy – barometer
• Alfred Traeger (1895–1980), Australia – Pedal radio
• Richard Trevithick (1771–1833), UK – high-pressure steam engine, first full-scale steam locomotive
• Franc Trkman (1903–1978), Slovenia – electrical switches, accessories for opening windows
• Hans Tropsch (1889–1935), together with Franz Joseph Emil Fischer (1877–1947), Germany – Fischer–Tropsch process (refinery process)
• Yuri Trutnev (born 1927), Russia – co-developer of the Tsar Bomb
• Roger Y. Tsien (1952–2016), together with Osamu Shimomura (1928–2018) and Martin Chalfie (born 1947), U.S. – Discovery and development of Green fluorescent protein
• Konstantin Tsiolkovsky (1857–1935), Russia – spaceflight
• Mikhail Tsvet (1872–1919), Russia – chromatography (specifically adsorption chromatography, the first chromatography method)
• Alexei Tupolev (1925–2001), Russia – the Tupolev Tu-144 (first supersonic passenger jet)
• Andrei Tupolev (1888–1972), Russia – turboprop powered long-range airliner (Tupolev Tu-114), turboprop strategic bomber (Tupolev Tu-95)
• Nasir-al-Din al-Tusi (1201–1274), Persia/Iran – observatory, Tusi-couple
• Sharaf al-Din al-Tusi (1135–1213), Persia/Iran – linear astrolabe
• Ralph Hart Tweddell (1843–1895), England – portable hydraulic riveter
• Shintaro Uda (1869–1976), together with Hidetsugu Yagi (1886–1976), Japan – Yagi-Uda antenna
• Lewis Urry (1927–2004), Canada – long-lasting alkaline battery
• Tomislav Uzelac, Croatia – first successful MP3 player, AMP
• Ira Van Gieson (1866–1913), U.S. – Van Gieson's stain (histology)
- Theophilus Van Kannel (1841–1919), United States – revolving door (1888)
- Vladimir Veksler (1907–1966), Russia – synchrophasotron, co-inventor of synchrotron
- John Venn (1834–1923), UK – Venn diagram (1881)
- Auguste Victor Louis Verneuil (1856–1913), France – Verneuil process (crystal growth)
- Pierre Vernier (1580–1637), France – Vernier scale (1631)
- Lucien Vidi (1805–1866), France – Barograph
- Edgar Villchur (1917–2011), U.S. – Acoustic suspension (loudspeaker)
- Artturi Ilmari Virtanen (1895–1973), Finland – AIV fodder
- Alessandro Volta (1745–1827), Italy – battery, see also Voltaic pile
- Bernard Vonnegut (1914–1997), together with Henry Chessin, and Richard E. Passarelli Jr., U.S. – Cloud seeding by silver iodide
- Ivan Vučetić (1858–1925), Croatia – Method of fingerprint classification
- Ruth Graves Wakefield (1903–1977), U.S. – chocolate chip cookie
- Paul Walden (1863–1957), Latvia/Russia/Germany – Walden inversion, Ethylammonium nitrate (the first room temperature ionic liquid)
- Madam C.J. Walker (1867–1919), U.S. – beauty and hair products for African American women
- Barnes Wallis (1887–1979), UK – bouncing bomb
- Frederick Walton (c. 1834–1928), UK – Linoleum
- Maurice Ward (1933–2011), UK – Starlite
- Robert Watson-Watt (1892–1973), Scotland – microwave radar
- James Watt (1736–1819), Scotland – improved Steam engine
- Thomas Wedgwood (1771–1805), UK – first (not permanent) photograph
- Carl Auer von Welsbach (1858–1929), Austria – Gas mantle, ferrocerium
- Jonas Wenström (1855–1893), Sweden – three-phase electrical power
- George Westinghouse (1846–1914), U.S. – Air brake (rail)
- Charles Wheatstone (1802–1875), UK – concertina, stereoscope, microphone, Playfair cipher, pseudoscope, dynamo
- Richard T. Whitcomb (1921–2009), U.S. – Supercritical airfoil, Winglet
• Eli Whitney (1765–1825), U.S. – the cotton gin
• Frank Whittle (1907–1996), UK – co-inventor of the jet engine
• Otto Wichterle (1913–1989), Czechoslovakia – soft contact lens
• Margaret Wilcox (born 1838) – automobile heater
• Norman Wilkinson (1878–1971), UK – Dazzle camouflage
• Charles Thomson Rees Wilson (1869–1959), UK – Cloud chamber
• Paul Winchell (1922–2005), U.S. – the artificial heart
• Sergei Winogradsky (1856–1953), Russia / USSR – Winogradsky column for culturing microorganisms
• Niklaus Wirth (born 1934), Switzerland – Pascal (programming language)
• A. Baldwin Wood (1879–1956), U.S. – high volume pump
• Norman Joseph Woodland (1921–2012), together with Bernard Silver (1924–1963), U.S. – Barcode
• Granville Woods (1856–1910), U.S. – the Synchronous Multiplex Railway Telegraph
• Steve Wozniak (born 1950), U.S. – Apple I & II computers, early Macintosh concepts, CL 9 CORE universal remote and other devices and applications.
• James Homer Wright (1869–1928), U.S. – Wright's stain (histology)
• Wright brothers, Orville (1871–1948) and Wilbur (1867–1912) – U.S. – powered airplane
• Arthur Wynne (1862–1945), UK – creator of crossword puzzle
• Yi Xing (683–727), China – Astronomical clock
• Pavel Yablochkov (1847–1894), Russia – Yablochkov candle (first commercially viable electric carbon arc lamp)
• Hidetsugu Yagi (1886–1976), together with Shintaro Uda (1896–1976), Japan – Yagi-Uda antenna
• Alexander Yakovlev (1906–1989), Russia – Yak-series aircraft, including Yakovlev Yak-40 (the first regional jet)
• Linus Yale Jr. (1821–1868), U.S. – cylinder lock
• Linus Yale Sr. (1797–1858), U.S. – pin tumbler lock
• Shunpei Yamazaki (born 1942), Japan – patents in computer science and solid-state physics, see List of prolific inventors
• Gazi Yasargil (born 1925), Turkey – Microneurosurgery
• Ryōuchi Yazu (1878–1908), Japan – Yazu Arithmometer
• Gunpei Yokoi (1941–1997), Japan – Game Boy
• Arthur M. Young (1905–1995), U.S. – the Bell Helicopter
• Vladimir Yourkevitch (1885–1964), Russia/France/U.S. – ship hull design
• Tu Youyou (born 1930), China – Artemisinin
• Sergei Yudin (1891–1954), Russia – cadaveric blood transfusion and other medical operations
• Muhammad Yunus (born 1940), Bangladesh – microcredit, microfinance
• Abu Yusuf Yaqub (c. 1274), Morocco/Spain – siege cannon
• Abraham Albert Yuzpe (inv. c. 1974), U.S. – Yuzpe regimen (= form of Emergency contraception)
• Abu al-Qasim al-Zahrawi (Abulcasis) (936–1013), Islamic Spain – catgut surgical suture, various surgical instruments and dental devices
• Frank Zamboni (1901–1988), U.S. – Ice resurfacer
• Giuseppe Zamboni (1776–1846), Italy – Zamboni pile (early battery)
• Ludwik Łazarz Zamenhof (1859–1917), Russia/Poland – Esperanto
• Walter Zapp (1905–2003), Latvia/Estonia/Germany – Minox (subminiature camera)
• Abū ʾIshāq ʿIbrāhīm al-Zarqālī (Arzachel) (1028–1087), Islamic Spain – almanac, equatorium, universal astrolabe
• Yevgeny Zavoisky (1907–1976), Russia – EPR spectroscopy, co-developer of NMR spectroscopy
• Nikolay Zelinsky (1861–1953), Russia – the first effective filtering coal gas mask in the world
• Ferdinand von Zeppelin (1838–1917), Germany – Zeppelin
• Frits Zernike (1888–1966), The Netherlands – Phase contrast microscope
• Tang Zhongming (1897–1980), China – internal combustion engine powered by charcoal
• Jian Zhou (1957–1999), together with Ian Hector Frazer (1953–), China/U.S. – HPV vaccine against cervical cancer
• Nikolai Zhukovsky (1847–1921), Russia – an early wind tunnel, co-developer of the Tsar Tank
• Karl Ziegler (1898–1973), together with Giulio Natta (1903–1979), Germany/Italy – Ziegler–Natta catalyst
• Franz Ziehl (1857–1926), together with Friedrich Neelsen (1854–1898), Germany – Ziehl–Neelsen stain (histology)
• Konrad Zuse (1910–1995), Germany – invented the first programmable general-purpose computer (Z1, Z2, Z3, Z4)
• Vasily Zvyozdochkin (1876–1956), Russia – matryoshka doll (together with Sergey Malyutin)
• Vladimir Zworykin (1889–1982), Russia/U.S. – Iconoscope, kinescope.
List of environmental issues

Issues

- **Human overpopulation** — Biocapacity climate change • Carrying capacity • Exploitation • Industrialisation • I = PAT • Land degradation • Land reclamation • Optimum population • Overshoot (population) • Population density • Population dynamics • Population growth • Projections of population growth • Total fertility rate • Urbanization • Waste • Water conflict • Water scarcity • Overdrafting

- **Hydrology** — Environmental impacts of reservoirs • Tile drainage • Hydrology (agriculture) • Flooding • Landslide

- **Intensive farming** — Agricultural subsidy • Environmental effects of meat production • Intensive animal farming • Intensive crop farming • Irrigation • Monoculture • Nutrient pollution • Overgrazing • Pesticide drift • Plasticulture • Slash and burn • Tile drainage

- **Land use** — Built environment • Desertification • Habitat fragmentation • Habitat destruction • Land degradation • Land pollution • Lawn-environmental concerns • Trail ethics • Urban heat island • Urban sprawl

- **Nanotechnology** — Impact of nanotechnology

- **Natural disasters**

- **Nuclear issues** — Nuclear fallout • Nuclear meltdown • Nuclear power • Nuclear weapons • Nuclear and radiation accidents • Nuclear safety • High-level radioactive waste management

- **Ocean trash**

- **Water Pollution**

Effects

- **Climate change** — Global warming • Global dimming • Fossil fuels • Sea level rise • Greenhouse gas • Ocean acidification • Shutdown of thermohaline circulation • Environmental impact of the coal industry • Urban Heat Islands • Flooding

- **Environmental degradation** — Habitat destruction • Invasive species

- **Environmental health** — Air quality • Asthma • Birth defect • Developmental disability • endocrine disruptors • Environmental impact of the coal industry • Environmental impact of nanotechnology • Electromagnetic field • Electromagnetic radiation and health • Indoor air quality • Lead poisoning • Leukemia • Nanotoxicology • Nature deficit disorder • One Health • Sick Building Syndrome • Environmental impact of hydraulic fracturing
• **Environmental issues with energy** — Environmental impact of the coal industry • Environmental impact of the energy industry • Environmental impact of hydraulic fracturing

• **Environmental issues with war** - Agent Orange • Depleted Uranium • Military Superfund site • Scorched earth • War and environmental law • Unexploded ordnance

• **Overpopulation** — Burial • Overpopulation in companion animals • Tragedy of the commons • Gender Imbalance in Developing Countries • Sub-replacement fertility levels in developed countries

• **Mutation breeding** — Genetic pollution

• **Synthetic biology** — Synthetic DNA — Artificially Expanded Genetic Information System — Hachimoji DNA

• **Genetically modified food** - Genetically modified crops - Genetically modified livestock

• **Pollution** — Nonpoint source pollution • Point source pollution

  Air pollution — Environmental impact of the coal industry • Environmental impact of hydraulic fracturing • Indoor air quality • Smog • Tropospheric ozone • Volatile organic compound • Atmospheric particulate matter • CFC • Biological effects of UV exposure

  Light pollution • Visual pollution

  Noise pollution

  Soil pollution — Alkali soil • Brownfield • Residual Sodium Carbonate Index • Soil conservation • Soil erosion • Soil contamination • Soil salination • Superfund • Superfund sites

  Water pollution — Acid rain • Agricultural runoff • Algal bloom • Environmental impact of the coal industry • Environmental impact of hydraulic fracturing • Eutrophication • Fish kill • Groundwater pollution • Groundwater recharge • Marine debris • Marine pollution • Mercury in fish • Microplastics • Nutrient pollution • Ocean acidification • Ocean dumping • Oil spills • Soda lake • Ship pollution • Thermal pollution • Urban runoff • Wastewater

  Space debris • Interplanetary contamination • Ozone depletion

• **Resource depletion** — Exploitation of natural resources • Overdrafting (groundwater) • Overexploitation

  **Consumerism** — Consumer capitalism • Planned obsolescence • Over-consumption

  **Fishing** — Blast fishing • Bottom trawling • Cyanide fishing • Ghost nets • Illegal, unreported and unregulated fishing • Overfishing • Shark culling • Shark finning • Whaling
Logging — Clearcutting • Deforestation • Illegal logging

Mining — Acid mine drainage • Environmental impact of hydraulic fracturing • Mountaintop removal mining • Slurry impoundments

Water (depletion) — Anoxic waters • Aral Sea • California Water Wars • Dead Sea • Lake Chad • Water scarcity

- Toxicants — Agent
  Orange • Asbestos • Beryllium • Bioaccumulation • Biomagnification • Chlorofluorocarbons (CFCs) • Cyanide • DDT • Endocrine disruptors • Explosives • Environmental impact of the coal industry • Herbicides • Hydrocarbons • Perchlorate • Pesticides • Persistent organic pollutant • PBBs • PBDEs • Toxic heavy metals • PCB • Dioxin • Polycyclic aromatic hydrocarbons • Radioactive contamination • Volatile organic compounds

- Waste — Electronic waste • Great Pacific Garbage Patch • Illegal dumping • Incineration • Litter • Waste disposal incidents • Marine debris • Medical waste • Landfill • Leachate • Toxic waste • Environmental impact of the coal industry • Exporting of hazardous waste

Mitigation

- Conservation
  - Ecosystems — Anoxic waters • Biodiversity • Biosecurity • Coral bleaching • Black carbon • Edge effect • Habitat destruction • Organic farming • Habitat fragmentation • In-situ leach
  - Fishing — Blast fishing • Bottom trawling • By-catch • Cetacean bycatch • Gillnetting • Illegal, unreported and unregulated fishing • Environmental effects of fishing • Marine pollution • Overfishing • Whaling
  - Forests — Clearcutting • Deforestation • Illegal logging • Trail ethics
  - Natural resources — Resource depletion • Exploitation of natural resources • Steady-state economy
  - Species — Endangered species • Genetic diversity • Habitat destruction • Holocene extinction • Invasive species • Poaching • Pollinator decline • Species extinction • Threshold host density • Wildlife trade • Wildlife disease
  - Energy conservation — Efficient energy use - Carfree city - Local food
  - Renewable energy — Renewable energy commercialization
  - Recreation — Protected areas
  - Water conservation
Disaster mitigation

Environmental law - Environmental crime • Environmental justice • Polluter pays principle • Precautionary principle • Regulatory capture - Trail ethics

List of security hacking incidents

1903

- Magician and inventor Nevil Maskelyne disrupts John Ambrose Fleming's public demonstration of Guglielmo Marconi's purportedly secure wireless telegraphy technology, sending insulting Morse code messages through the auditorium's projector.

1932

- Polish cryptologists Marian Rejewski, Henryk Zygalski and Jerzy Różycki broke the Enigma machine code.

1939

- Alan Turing, Gordon Welchman and Harold Keen worked together to develop the Bombe (on the basis of Rejewski's works on Bomba). The Enigma machine's use of a reliably small key space makes it vulnerable to brute force.

1943

- René Carmille, comptroller general of the Vichy French Army, hacked the punched card system used by the Nazis to locate Jews.

1949

- The theory that underlies computer viruses was first made public in 1949, when computer pioneer John von Neumann presented a paper titled "Theory and Organization of Complicated Automata." In the paper von Neumann speculated that computer programs could reproduce themselves.
1955

- At MIT, "hack" first came to mean fussing with machines. The minutes of an April, 1955, meeting of the Tech Model Railroad Club state that "Mr. Eccles requests that anyone working or hacking on the electrical system turn the power off to avoid fuse blowing."

1957

- Joe "Joybubbles" Engressia, a blind seven-year-old boy with perfect pitch, discovered that whistling the fourth E above middle C (a frequency of 2600 Hz) would interfere with AT&T's automated telephone systems, thereby inadvertently opening the door for phreaking.

1960

- Various phreaking boxes are used to interact with automated telephone systems.

1963

- The first ever reference to malicious hacking is 'telephone hackers' in MIT's student newspaper, The Tech of hackers tying up the lines with Harvard, configuring the PDP-1 to make free calls, war dialing and accumulating large phone bills.

1965

- William D. Mathews from MIT found a vulnerability in a CTSS running on an IBM 7094. The standard text editor on the system was designed to be used by one user at a time, working in one directory, and so created a temporary file with a constant name for all instantiations of the editor. The flaw was discovered when two system programmers were editing at the same time and the temporary files for the message-of-the-day and the password file became swapped, causing the contents of the system CTSS password file to display to any user logging into the system.

1967

- The first known incidence of network penetration hacking took place when members of a computer club at a suburban Chicago area high school were provided access to IBM's APL network. In the Fall of 1967, IBM (through Science Research Associates) approached Evanston Township High School with the offer of four 2741 Selectric teletypewriter based terminals with dial-up modem connectivity to an experimental computer system which implemented an early version of the APL programming language. The APL
network system was structured in Workspaces which were assigned to various clients using the system. Working independently, the students quickly learned the language and the system. They were free to explore the system, often using existing code available in public Workspaces as models for their own creations. Eventually, curiosity drove the students to explore the system's wider context. This first informal network penetration effort was later acknowledged as helping harden the security of one of the first publicly accessible networks:

Science Research Associates undertook to write a full APL system for the IBM 1500. They modeled their system after APL/360, which had by that time been developed and seen substantial use inside of IBM, using code borrowed from MAT/1500 where possible. In their documentation they acknowledge their gratitude to "a number of high school students for their compulsion to bomb the system". This was an early example of a kind of sportive, but very effective, debugging that was often repeated in the evolution of APL systems.

1971

- John T. Draper (later nicknamed Captain Crunch), his friend Joe Engressia (also known as Joybubbles), and blue box phone phreaking hit the news with an Esquire Magazine feature story.

1979

- Kevin Mitnick breaks into his first major computer system, the Ark, the computer system Digital Equipment Corporation (DEC) used for developing their RSTS/E operating system software.

1980

- The FBI investigates a breach of security at National CSS (NCSS). The New York Times, reporting on the incident in 1981, describes hackers as technical experts; skilled, often young, computer programmers, who almost whimsically probe the defenses of a computer system, searching out the limits and the possibilities of the machine. Despite their seemingly subversive role, hackers are a recognized asset in the computer industry, often highly prized. The newspaper describes white hat activities as part of a "mischievous but perversely positive 'hacker' tradition". When a National CSS employee revealed the existence of his password cracker, which he had used on customer accounts, the company chastised him not for writing the software but for not disclosing it sooner. The letter of reprimand stated that "The Company realizes the benefit to NCSS and in fact encourages the efforts of employees to identify security weaknesses to the VP, the directory, and other sensitive software in files".
1981

- Chaos Computer Club forms in Germany.
- Ian Murphy aka Captain Zap, was the first cracker to be tried and convicted as a felon. Murphy broke into AT&T's computers in 1981 and changed the internal clocks that metered billing rates. People were getting late-night discount rates when they called at midday. Of course, the bargain-seekers who waited until midnight to call long distance were hit with high bills.

1983

- The 414s break into 60 computer systems at institutions ranging from the Los Alamos National Laboratory to Manhattan's Memorial Sloan-Kettering Cancer Center. The incident appeared as the cover story of Newsweek with the title "Beware: Hackers at play". As a result, the U.S. House of Representatives held hearings on computer security and passed several laws.
- The group KILOBAUD is formed in February, kicking off a series of other hacker groups which form soon after.
- The movie WarGames introduces the wider public to the phenomenon of hacking and creates a degree of mass paranoia of hackers and their supposed abilities to bring the world to a screeching halt by launching nuclear ICBMs.
- The U.S. House of Representatives begins hearings on computer security hacking.
- In his Turing Award lecture, Ken Thompson mentions "hacking" and describes a security exploit that he calls a "Trojan horse".

1984

- Someone calling himself Lex Luthor founds the Legion of Doom. Named after a Saturday morning cartoon, the LOD had the reputation of attracting "the best of the best"—until one of the most talented members called Phiber Optik feuded with Legion of Doomer Erik Bloodaxe and got 'tossed out of the clubhouse'. Phiber's friends formed a rival group, the Masters of Deception.
- Cult of the Dead Cow forms in Lubbock, Texas, and begins publishing its ezine.
- The hacker magazine 2600 begins regular publication, right when TAP was putting out its final issue. The editor of 2600, "Emmanuel Goldstein" (whose real name is Eric Corley), takes his handle from the leader of the resistance in George Orwell's 1984. The publication provides tips for would-be hackers and phone phreaks, as well as commentary on the hacker issues of the day. Today, copies of 2600 are sold at most large retail bookstores.
The Chaos Communication Congress, the annual European hacker conference organized by the Chaos Computer Club, is held in Hamburg, Germany.

William Gibson's groundbreaking science fiction novel *Neuromancer*, about "Case", a futuristic computer hacker, is published. Considered the first major cyberpunk novel, it brought into hacker jargon such terms as "cyberspace", "the matrix", "simstim", and "ICE".

1985

- KILOBAUD is re-organized into The P.H.I.R.M., and begins sysopping hundreds of BBSs throughout the United States, Canada, and Europe.
- The online 'zine *Phrack* is established.
- *The Hacker's Handbook* is published in the UK.
- The FBI, Secret Service, Middlesex County NJ Prosecutor's Office and various local law enforcement agencies execute seven search warrants concurrently across New Jersey on July 12, 1985, seizing equipment from BBS operators and users alike for "complicity in computer theft", under a newly passed, and yet untested criminal statute. This is famously known as the Private Sector Bust, or the 2600 BBS Seizure, and implicated the Private Sector BBS sysop, Store Manager (also a BBS sysop), Beowulf, Red Barchetta, The Vampire, the NJ Hack Shack BBS sysop, and the Treasure Chest BBS sysop.

1986

- After more and more break-ins to government and corporate computers, Congress passes the Computer Fraud and Abuse Act, which makes it a crime to break into computer systems. The law, however, does not cover juveniles.
- Robert Schifreen and Stephen Gold are convicted of accessing the Telecom Gold account belonging to the Duke of Edinburgh under the Forgery and Counterfeiting Act 1981 in the United Kingdom, the first conviction for illegally accessing a computer system. On appeal, the conviction is overturned as hacking is not within the legal definition of forgery.
- Arrest of a hacker who calls himself The Mentor. He published a now-famous treatise shortly after his arrest that came to be known as the Hacker's Manifesto in the e-zine Phrack. This still serves as the most famous piece of hacker literature and is frequently used to illustrate the mindset of hackers.
1987

- The Christmas Tree EXEC "worm" causes major disruption to the VNET, BITNET and EARN networks.

1988

- The *Morris Worm*. Graduate student Robert T. Morris, Jr. of Cornell University launches a worm on the government's ARPAnet (precursor to the Internet). The worm spreads to 6,000 networked computers, clogging government and university systems. Robert Morris is dismissed from Cornell, sentenced to three years probation, and fined $10,000.
- First National Bank of Chicago is the victim of $70-million computer theft.
- The Computer Emergency Response Team (CERT) is created by DARPA to address network security.
- The Father Christmas (computer worm) spreads over DECnet networks.

1989

- Jude Milhon (aka St Jude) and R. U. Sirius launch Mondo 2000, a major '90s tech-lifestyle magazine, in Berkeley, California.
- The politically motivated WANK worm spreads over DECnet.
- Dutch magazine Hack-Tic begins.
- The Cuckoo's Egg by Clifford Stoll is published.
- The detection of AIDS (Trojan horse) is the first instance of a ransomware detection.

1990

- Operation Sundevil introduced. After a prolonged sting investigation, Secret Service agents swoop down on organizers and prominent members of BBSs in 14 U.S. cities including the Legion of Doom, conducting early-morning raids and arrests. The arrests involve and are aimed at cracking down on credit-card theft and telephone and wire fraud. The result is a breakdown in the hacking community, with members informing on each other in exchange for immunity. The offices of Steve Jackson Games are also raided, and the role-playing sourcebook GURPS Cyberpunk is confiscated, possibly because the government fears it is a "handbook for computer crime". Legal battles arise that prompt the formation of the Electronic Frontier Foundation, including the trial of Knight Lightning.
- Australian federal police tracking *Realm* members *Phoenix*, *Electron* and *Nom* are the first in the world to use a remote data intercept to gain evidence for a computer crime prosecution.
- The Computer Misuse Act 1990 is passed in the United Kingdom, criminalising any unauthorised access to computer systems.

1992

- Release of the movie *Sneakers*, in which security experts are blackmailed into stealing a universal decoder for encryption systems.
- One of the first ISPs, MindVox, opens to the public.
- Bulgarian virus writer Dark Avenger wrote 1260, the first known use of polymorphic code, used to circumvent the type of pattern recognition used by antivirus software, and nowadays also intrusion detection systems.
- Publication of a hacking instruction manual for penetrating TRW credit reporting agency by Infinite Possibilities Society (IPS) gets Dr. Ripco, the sysop of Ripco BBS mentioned in the IPS manual, arrested by the United States Secret Service.

1993

- The first DEF CON hacking conference takes place in Las Vegas. The conference is meant to be a one-time party to say good-bye to BBSs (now replaced by the Web), but the gathering was so popular it became an annual event.
- AOL gives its users access to Usenet, precipitating Eternal September.

1994

- Summer: Russian crackers siphon $10 million from Citibank and transfer the money to bank accounts around the world. Vladimir Levin, the 30-year-old ringleader, used his work laptop after hours to transfer the funds to accounts in Finland and Israel. Levin stands trial in the United States and is sentenced to three years in prison. Authorities recover all but $400,000 of the stolen money.
- Hackers adapt to emergence of the World Wide Web quickly, moving all their how-to information and hacking programs from the old BBSs to new hacker web sites.
- AOHell is released, a freeware application that allows a burgeoning community of unskilled script kiddies to wreak havoc on America Online. For days, hundreds of thousands of AOL users find their mailboxes flooded with multi-megabyte email bombs and their chat rooms disrupted with spam messages.
- December 27: After experiencing an IP spoofing attack by Kevin Mitnick, computer security expert Tsutomu Shimomura started to receive prank calls that popularized the phrase "My kung fu is stronger than yours".
1995

- The movies *The Net* and *Hackers* are released.
- The Canadian ISP dlcwest.com is hacked and website replaced with a graphic and the caption "You've been hacked MOFO"
- February 22: The FBI raids the "Phone Masters".

1996

- Hackers alter Web sites of the United States Department of Justice (August), the CIA (October), and the U.S. Air Force (December).
- Canadian hacker group, Brotherhood, breaks into the Canadian Broadcasting Corporation.
- Arizona hacker, John Sabo A.K.A FizzleB/Peanut, was arrested for hacking Canadian ISP dlcwest.com claiming the company was defrauding customers through over billing.
- The U.S. General Accounting Office reports that hackers attempted to break into Defense Department computer files some 250,000 times in 1995 alone. About 65 percent of the attempts were successful, according to the report.
- Cryptovirology is born with the invention of the cryptoviral extortion protocol that would later form the basis of modern ransomware.

1997

- A 15-year-old Croatian youth penetrates computers at a U.S. Air Force base in Guam.
- June: Eligible Receiver 97 tests the American government's readiness against cyberattacks.
- First high-profile attacks on Microsoft's Windows NT operating system

1998

- January: Yahoo! notifies Internet users that anyone visiting its site in the past month might have downloaded a logic bomb and worm planted by hackers claiming a "logic bomb" will go off if computer hacker Kevin Mitnick is not released from prison.
- February: The Internet Software Consortium proposes the use of DNSSEC (domain-name system security extensions) to secure DNS servers.
May 19: The seven members of the hacker think tank known as L0pht testify in front of the US congressional Government Affairs committee on "Weak Computer Security in Government".

June: Information Security publishes its first annual Industry Survey, finding that nearly three-quarters of organizations suffered a security incident in the previous year.

September: Electronic Disturbance Theater, an online political performance-art group, attacks the websites of The Pentagon, Mexican president Ernesto Zedillo, and the Frankfurt Stock Exchange, calling it conceptual art and claiming it to be a protest against the suppression of the Zapatista Army of National Liberation in southern Mexico. EDT uses the FloodNet software to bombard its opponents with access requests.


1999

Software security goes mainstream In the wake of Microsoft's Windows 98 release, 1999 becomes a banner year for security (and hacking). Hundreds of advisories and patches are released in response to newfound (and widely publicized) bugs in Windows and other commercial software products. A host of security software vendors release anti-hacking products for use on home computers.

U.S. President Bill Clinton announces a $1.46 billion initiative to improve government computer security. The plan would establish a network of intrusion detection monitors for certain federal agencies and encourage the private sector to do the same.

January 7: The "Legion of the Underground" (LoU) declares "war" against the governments of Iraq and the People's Republic of China. An international coalition of hackers (including Cult of the Dead Cow, 2600's staff, Phrack's staff, L0pht, and the Chaos Computer Club) issued a joint statement condemning the LoU's declaration of war. The LoU responded by withdrawing its declaration.

March: The Melissa worm is released and quickly becomes the most costly malware outbreak to date.

July: Cult of the Dead Cow releases Back Orifice 2000 at DEF CON.

August: Kevin Mitnick, sentenced to 5 years, of which over 4 years had already been spent pre-trial including 8 months solitary confinement.

September: Level Seven Crew hacks the U.S. Embassy in China's website and places racist, anti-government slogans on embassy site in regards to 1998 U.S. embassy bombings.

September 16: The United States Department of Justice sentences the "Phone Masters".

October: American Express introduces the "Blue" smart card, the industry's first chip-based credit card in the US.
November 17: A hacker interviewed by Hilly Rose during the radio show *Coast to Coast AM* (then hosted by Art Bell) exposes a plot by al-Qaeda to derail Amtrak trains. This results in all trains being forcibly stopped over Y2K as a safety measure.

2000

- May: The ILOVEYOU worm, also known as VBS/Loveletter and Love Bug worm, is a computer worm written in VBScript. It infected millions of computers worldwide within a few hours of its release. It is considered to be one of the most damaging worms ever. It originated in the Philippines; made by an AMA Computer College student Onel de Guzman for his thesis.
- September: Computer hacker Jonathan James became the first juvenile to serve jail time for hacking.

2001

- Microsoft becomes the prominent victim of a new type of hack that attacks the domain name server. In these denial-of-service attacks, the DNS paths that take users to Microsoft's websites are corrupted.
- February: A Dutch cracker releases the Anna Kournikova virus, initiating a wave of viruses that tempts users to open the infected attachment by promising a sexy picture of the Russian tennis star.
- April: FBI agents trick two Russian crackers into coming to the U.S. and revealing how they were hacking U.S. banks.
- July: Russian programmer Dmitry Sklyarov is arrested at the annual Def Con hacker convention. He was the first person criminally charged with violating the Digital Millennium Copyright Act (DMCA).
- August: Code Red worm, infects tens of thousands of machines.
- The National Cyber Security Alliance (NCSA) is established in response to the September 11 attacks on the World Trade Center.

2002

- January: Bill Gates decrees that Microsoft will secure its products and services, and kicks off a massive internal training and quality control campaign.
- May: Klez.H, a variant of the worm discovered in November 2001, becomes the biggest malware outbreak in terms of machines infected, but causes little monetary damage.
- June: The Bush administration files a bill to create the Department of Homeland Security, which, among other things, will be responsible for protecting the nation's critical IT infrastructure.
August: Researcher Chris Paget publishes a paper describing "shatter attacks", detailing how Windows' unauthenticated messaging system can be used to take over a machine. The paper raises questions about how securable Windows could ever be. It is however largely derided as irrelevant as the vulnerabilities it described are caused by vulnerable applications (placing windows on the desktop with inappropriate privileges) rather than an inherent flaw within the Operating System.

October: The International Information Systems Security Certification Consortium - (ISC)^2 - confers its 10,000th CISSP certification.

2003

- The hacktivist group Anonymous was formed.
- March: Cult of the Dead Cow and Hacktivismo are given permission by the United States Department of Commerce to export software utilizing strong encryption.

2004

- March: New Zealand's Government (National Party) website defaced by hacktivist group BlackMask
- July: North Korea claims to have trained 500 hackers who successfully crack South Korean, Japanese, and their allies' computer systems.
- October: National Cyber Security Awareness Month was launched by the National Cyber Security Alliance and U.S. Department of Homeland Security.

2005

- April 2: Rafael Núñez (aka RaFa), a notorious member of the hacking group World of Hell, is arrested following his arrival at Miami International Airport for breaking into the Defense Information Systems Agency computer system in June 2001.
- September 13: Cameron Lacroix is sentenced to 11 months for gaining access to T-Mobile's network and exploiting Paris Hilton's Sidekick.
- November 3: Jeanson James Ancheta, whom prosecutors say was a member of the "Botmaster Underground", a group of script kiddies mostly noted for their excessive use of bot attacks and propagating vast amounts of spam, was taken into custody after being lured to FBI offices in Los Angeles.
2006

- **January:** One of the few worms to take after the old form of malware, destruction of data rather than the accumulation of zombie networks to launch attacks from, is discovered. It had various names, including Kama Sutra (used by most media reports), Black Worm, Mywife, Blackmal, Nyxem version D, Kapser, KillAV, Grew and CME-24. The worm would spread through e-mail client address books, and would search for documents and fill them with garbage, instead of deleting them to confuse the user. It would also hit a web page counter when it took control, allowing the programmer who created it as well as the world to track the progress of the worm. It would replace documents with random garbage on the third of every month. It was hyped by the media but actually affected relatively few computers, and was not a real threat for most users.

- **May:** Jeanson James Ancheta receives a 57-month prison sentence, and is ordered to pay damages amounting to $15,000.00 to the Naval Air Warfare Center in China Lake and the Defense Information Systems Agency, for damage done due to DDoS attacks and hacking. Ancheta also had to forfeit his gains to the government, which include $60,000 in cash, a BMW, and computer equipment.

- **May:** The largest defacement in Web History as of that time is performed by the Turkish hacker iSKORPiTX who successfully hacked 21,549 websites in one shot.

- **July:** Edwin Pena is the first person to be charged by U.S. authorities with VoIP hacking. He was sentenced to 10 years and a $1 million restitution.

- **September:** Viodentia releases FairUse4WM tool which would remove DRM information off Windows Media Audio (WMA) files downloaded from music services such as Yahoo! Unlimited, Napster, Rhapsody Music and Urge.

2007

- **May 17:** Estonia recovers from massive denial-of-service attack

- **June 13:** FBI Operation Bot Roast finds over 1 million botnet victims

- **June 21:** A spear phishing incident at the Office of the Secretary of Defense steals sensitive U.S. defense information, leading to significant changes in identity and message-source verification at OSD.

- **August 11:** United Nations website hacked by Turkish Hacker Kerem125.

- **November 14:** Panda Burning Incense which is known by several other names, including Fujacks and Radoppan.T lead to the arrest of eight people in China. Panda Burning Incense was a parasitic virus that infected executable files on a PC. When infected, the icon of the executable file changes to an image of a panda holding three sticks of incense. The arrests were the first for virus writing in China.
2008

- January 17: Project Chanology; Anonymous attacks Scientology website servers around the world. Private documents are stolen from Scientology computers and distributed over the Internet.
- March 7: Around 20 Chinese hackers claim to have gained access to the world’s most sensitive sites, including The Pentagon. They operated from an apartment on a Chinese Island.
- March 14: Trend Micro website successfully hacked by Turkish hacker Janizary (aka Utku).

2009

- April 4: Conficker worm infiltrated millions of PCs worldwide including many government-level top-security computer networks.

2010

- January 12: Operation Aurora Google publicly reveals that it has been on the receiving end of a "highly sophisticated and targeted attack on our corporate infrastructure originating from China that resulted in the theft of intellectual property from Google"
- June: Stuxnet The Stuxnet worm is found by VirusBlokAda. Stuxnet was unusual in that while it spread via Windows computers, its payload targeted just one specific model and type of SCADA systems. It slowly became clear that it was a cyber attack on Iran’s nuclear facilities - with most experts believing that Israel was behind it - perhaps with US help.
- December 3: The first Malware Conference, MALCON took place in India. Founded by Rajshekhar Murthy, malware coders are invited to showcase their skills at this annual event supported by the Government of India. An advanced malware for Symbian OS is released by hacker A0drul3z.

2011

- The hacker group Lulz Security is formed.
- April 9: Bank of America website got hacked by a Turkish hacker named JeOPaRDY. An estimated 85,000 credit card numbers and accounts were reported to have been stolen due to the hack. Bank officials say no personal customer bank information is available on that web-page. Investigations are being conducted by the FBI to trace down the incriminated hacker.
- April 17: An "external intrusion" sends the PlayStation Network offline, and compromises personally identifying information (possibly including credit card details) of its 77 million accounts, in what is claimed to be one of the five largest data breaches ever.
- Computer hacker sl1nk releases information of his penetration in the servers of the Department of Defense (DoD), Pentagon, NASA, NSA, US Military, Department of the Navy, Space and Naval Warfare System Command and other UK/US government websites.

- September: Bangladeshi hacker TiGER-M@TE made a world record in defacement history by hacking 700,000 websites in a single shot.

- October 16: The YouTube channel of Sesame Street was hacked, streaming pornographic content for about 22 minutes.

- November 1: The main phone and Internet networks of the Palestinian territories sustained a hacker attack from multiple locations worldwide.

- November 7: The forums for Valve's Steam service were hacked. Redirects for a hacking website, Fkn0wned, appeared on the Steam users' forums, offering "hacking tutorials and tools, porn, free giveaways and much more."

- December 14: Five members of the Norwegian hacker group, Noria, were arrested, allegedly suspected for hacking into the email account of the militant extremist Anders Behring Breivik (who perpetrated the 2011 attacks in the country).

**2012**

- A Saudi hacker, 0XOMAR, published over 400,000 credit cards online, and threatened Israel to release 1 million credit cards in the future. In response to that incident, an Israeli hacker published over 200 Saudi's credit cards online.

- January 7: "Team Appunity", a group of Norwegian hackers, were arrested for breaking into Norway's largest prostitution website then publishing the user database online.

- February 3: Marriott was hacked by a New Age ideologist, Attila Nemeth who was resisting against the New World Order where he said that corporations are allegedly controlling the world. As a response Marriott reported him to the United States Secret Service.

- February 8: Foxconn is hacked by a hacker group, "Swagg Security", releasing a massive amount of data including email and server logins, and even more alarming - bank account credentials of large companies like Apple and Microsoft. Swagg Security stages the attack just as a Foxconn protest ignites against terrible working conditions in southern China.

- May 4: The websites of several Turkish representative offices of international IT-companies are defaced within the same day by F0RTYS3V3N (Turkish Hacker), including the websites of Google, Yandex, Microsoft, Gmail, MSN, Hotmail, PayPal.

- May 24: WHMCS is hacked by UGNazi, they claim that the reason for this is because of the illegal sites that are using their software.
• May 31: MyBB is hacked by newly founded hacker group, UGNazi, the website was defaced for about a 
day, they claim their reasoning for this was because they were upset that the forum board Hackforums.net 
uses their software.

• June 5: The social networking website LinkedIn has been hacked and the passwords for nearly 6.5 million 
user accounts are stolen by cybercriminals. As a result, a United States grand jury indicted Nikulin and 
three unnamed co-conspirators on charges of aggravated identity theft and computer intrusion.

• August 15: The most valuable company in the world Saudi Aramco is crippled by a cyber warfare attack 
for months by malware called Shamoon. Considered the biggest hack in history in terms of cost and 
destructiveness. Carried out by an Iranian attacker group called Cutting Sword of Justice. Iranian hackers 
retaliated against Stuxnet by releasing Shamoon. The malware destroyed over 35,000 Saudi Aramco 
computers, affecting business operations for months.

• December 17: Computer hacker sl1nk announced that he has hacked a total of 9 
countries' SCADA systems. The proof includes 6 countries: France, Norway, Russia, Spain, Sweden and 
the United States.

2013

• The social networking website Tumblr is attacked by hackers. Consequently, 65,469,298 unique emails and 
passwords were leaked from Tumblr. The data breach's legitimacy is confirmed by computer security 
researcher Troy Hunt.

2014

• February 7: The bitcoin exchange Mt. Gox filed for bankruptcy after $460 million was apparently stolen by 
hackers due to "weaknesses in [their] system" and another $27.4 million went missing from its bank 
accounts.

• October: The White House computer system was hacked. It was said that the FBI, the Secret Service, and 
other U.S. intelligence agencies categorized the attacks "among the most sophisticated attacks ever 
launched against U.S. government systems."

• November 24: In response to the release of the film The Interview, the servers of Sony 
Pictures are hacked by a hacker group calling itself "Guardian of Peace".

• November 28: The website of the Philippine telecommunications company Globe Telecom was hacked in 
response to the poor internet service they are distributing.
2015

- June: the records of 21.5 million people, including social security numbers, dates of birth, addresses, fingerprints, and security-clearance-related information, are stolen from the United States Office of Personnel Management (OPM). Most of the victims are employees of the United States government and unsuccessful applicants to it. The *Wall Street Journal* and the *Washington Post* report that government sources believe the hacker is the government of China.
- July: The servers of extramarital affairs website Ashley Madison were breached.

2016

- February: The 2016 Bangladesh Bank heist attempted to steal US$951 million from a Bangladesh Bank, and succeeded in getting $101 million - although some of this was later recovered.
- July 22: WikiLeaks published the documents from the 2016 Democratic National Committee email leak.
- July 29: a group suspected coming from China launched hacker attacks on the website of Vietnam Airlines.
- August 13: The Shadow Brokers (TSB) started publishing several leaks containing hacking tools from the National Security Agency (NSA), including several zero-day exploits. Ongoing leaks until April 2017 (The Shadow Brokers)
- September: Hacker Ardit Ferizi is sentenced to 20 years in prison after being arrested for hacking U.S. servers and passing the leaked information to members of ISIL terrorist group back in 2015.
- October: The 2016 Dyn cyberattack is being conducted with a botnet consisting of IOTs infected with Mirai by the hacktivist groups SpainSquad, Anonymous, and New World Hackers, reportedly in retaliation for Ecuador's rescinding Internet access to WikiLeaks founder Julian Assange at their embassy in London, where he has been granted asylum.
- Late 2016: Hackers steal international personal user data from the company Uber, including phone numbers, email addresses, and names, of 57 million people and 600,000 driver's license numbers of drivers for the company. Uber's GitHub account was accessed through Amazon's cloud-based service. Uber paid the hackers $100,000 for assurances the data was destroyed.

2017

- April: A hacker group calling itself "The Dark Overlord" posted unreleased episodes of *Orange Is the New Black* TV series online after failing to extort the online entertainment company Netflix.
- May: WannaCry ransomware attack started on Friday, 12 May 2017, and has been described as unprecedented in scale, infecting more than 230,000 computers in over 150 countries. A hacked unreleased Disney film is held for ransom, to be paid in Bitcoin.
• May: 25,000 digital photos and ID scans relating to patients of the Grozio Chirurgija cosmetic surgery clinic in Lithuania were obtained and published without consent by an unknown group demanding ransoms. Thousands of clients from more than 60 countries were affected. The breach brought attention to weaknesses in Lithuania's information security.
• June: 2017 Petya cyberattack.
• June: TRITON (TRISIS), a malware framework designed to reprogram Triconex safety instrumented systems (SIS) of industrial control systems (ICS), discovered in Saudi Arabian Petrochemical plant.
• August: Hackers demand $7.5 million in bitcoin to stop pre-releasing HBO shows and scripts, including Ballers, Room 104 and Game of Thrones.
• September 2017: Deloitte breach.
• December: Mecklenburg County, North Carolina computer systems were hacked. They did not pay the ransom.

2018

• March: The city of Atlanta, Georgia USA computer systems are seized by hackers with ransomware. They did not pay the ransom, and two Iranians were indicted by the FBI on cyber crime charges for the breach.
• The town of Wasaga Beach in Ontario, Canada computer systems are seized by hackers with ransomware.
• October: West Haven, Connecticut USA computer systems are seized by hackers with ransomware, they paid $2,000 in ransom.
• November:
  o The first U.S. indictment of individual people for ransomware attacks occurs. The U.S. Justice Department indicted two men Faramarz Shahi Savandi and Mohammad Mehdi Shah Mansouri who allegedly used the SamSam ransomware for extortion, netting them more than $6 million in ransom payments. The companies infected with the ransomware included Allscripts, Medstar Health, and Hollywood Presbyterian Medical Center. Altogether, the attacks caused victims to lose more than $30 million, in addition to the ransom payments.
  o Marriott disclosed that its Starwood Hotel brand had been subject to a security breach.

2019

• March: Jackson County, Georgia USA computer systems are seized by hackers with ransomware, they paid $400,000 in ransom. The city of Albany, New York USA experiences a ransomware cyber attack.
- April: The city of Augusta, Maine USA computer systems are seized by hackers using ransomware. The city of Greenville, North Carolina USA computer systems are seized by hackers using ransomware known as RobbinHood. Imperial County, in California USA, computer systems are seized by hackers using Ryuk ransomware.

- May: The city of Baltimore, Maryland USA computer systems are seized by hackers using ransomware known as RobbinHood that encrypts files with a "file-locking" virus, as well as the tool EternalBlue.

- June: The city of Riviera Beach, Florida USA paid roughly $600,000 ransom in Bitcoin to hackers who seized their computers using ransomware. Hackers stole 18 hours of unreleased music from the band Radiohead demanding $150,000 ransom. Radiohead released the music to the public anyway and did not pay the ransom.

2020

- February: Anonymous hacked the United Nation's website and created a page for Taiwan, a country which has not had a seat at the UN since 1971. The hacked page featured the Flag of Taiwan, the KMT emblem, a Taiwan Independence flag, the Anonymous logo, and embedded YouTube videos such as the Taiwanese national anthem and the closing score for the 2019 film *Avengers: Endgame* titled "It's Been a Long, Long Time", along with a caption. The hacked server belonged to the United Nations Department of Economic and Social Affairs.

**List of inventors killed by their own inventions**

- Sylvester H. Roper, inventor of the eponymous steam-powered bicycle, died of a heart attack or subsequent crash during a public speed trial in 1896. It is unknown whether the crash caused the heart attack or the heart attack caused the crash.

- William Nelson (c. 1879–1903), a General Electric employee, invented a new way to motorize bicycles. He then fell off his prototype bike during a test run.

- Francis Edgar Stanley (1849–1918) was killed while driving a Stanley Steamer automobile. He drove his car into a woodpile while attempting to avoid farm wagons travelling side by side on the road.

- Fred Duesenberg (1876–1932) was killed in a high-speed road accident in a Duesenberg automobile.

- Ismail ibn Hammad al-Jawhari (died c. 1003–1010), a Kazakh Turkic scholar from Farab, attempted to fly using two wooden wings and a rope. He leapt from the roof of a mosque in Nishapur and fell to his death.
Jean-François Pilâtre de Rozier was the first known fatality in an air crash when his Rozière balloon crashed on 15 June 1785 while he and Pierre Romain attempted to cross the English Channel.

Otto Lilienthal (1848–1896) died the day after crashing one of his hang gliders.

Franz Reichelt (1879–1912), a tailor, fell to his death off the first deck of the Eiffel Tower while testing his invention, the coat parachute. It was his first attempt with the parachute, and he had told the authorities he would first test it with a dummy.

Aurel Vlaicu (1882–1913) died when his self-constructed airplane, Vlaicu II, failed during an attempt to cross the Carpathian Mountains.

Henry Smolinski (died 1973) was killed during a test flight of the AVE Mizar, a flying car based on the Ford Pinto and the sole product of the company he founded.

Michael Dacre (died 2009, age 53) died after testing his flying taxi device designed to permit fast, affordable travel between regional cities.

Andrei Zheleznyakov, a Soviet scientist, was developing chemical weapons in 1987 when a hood malfunction exposed him to traces of the nerve agent Novichok 5. He spent weeks in a coma, months unable to walk, and years suffering failing health before dying from its effects in 1992/3.

William Bullock (1813–1867) invented the web rotary printing press. Several years after its invention, his foot was crushed during the installation of a new machine in Philadelphia. The crushed foot developed gangrene and Bullock died during the amputation.

Henry Winstanley (1644–1703) built the first lighthouse on the Eddystone Rocks in Devon, England between 1696 and 1698. During the Great Storm of 1703 the lighthouse was completely destroyed with Winstanley and five other men inside. No trace of them was found.

Horace Lawson Hunley (died 1863, age 40), Confederate inventor, Hunley, drowned with seven other crew members during a test of his invention, the first combat submarine.

Thomas Andrews, Jr. (1873–1912) was an Irish born British businessman and shipbuilder. He was managing director and head of the drafting department of the shipbuilding company Harland and Wolff in Belfast, Ireland. As the naval architect in charge of the plans for the ocean liner RMS Titanic, he was travelling on board that vessel during her maiden voyage when the ship hit an iceberg on 14 April 1912. He perished along with more than 1,500 others. His body was never recovered.

Alexander Bogdanov (1873–1928) was a Russian physician, philosopher, science fiction writer and revolutionary of Belarusian ethnicity who experimented with blood transfusion, attempting to achieve eternal youth or at least partial rejuvenation. He died after he took the blood of a student suffering from malaria and tuberculosis, who may have also been the wrong blood type.

Thomas Midgley, Jr. (1889–1944) was an American engineer and chemist who contracted polio at age 51, leaving him severely disabled. He devised an elaborate system of ropes and pulleys to help others lift him
from bed. He became accidentally entangled in the ropes and died of strangulation at the age of 55. However, he is better known for two of his other inventions: the tetraethyl lead (TEL) additive to gasoline, and chlorofluorocarbons (CFCs).

- Sabin Arnold von Sochocky invented the first radium-based luminescent paint, but eventually died, in 1928, of aplastic anemia resulting from his exposure to the radioactive material.
- Karel Soucek (1947–1985) was a Canadian professional stuntman who developed a shock-absorbent barrel. He died following a demonstration involving the barrel being dropped from the roof of the Houston Astrodome. He was fatally wounded when his barrel hit the rim of the water tank meant to cushion his fall.
- Valerian Abakovsky (1895–1921) constructed the Aerowagon, an experimental high-speed railcar fitted with an aircraft engine and propeller traction, intended to carry Soviet officials. On 24 July 1921, it derailed at high speed, killing 6 of the 22 on board, including Abakovsky.
- Max Valier (1895–1930) invented liquid-fuelled rocket engines as a member of the 1920s German rocket society Verein für Raumschiffahrt. On 17 May 1930, an alcohol-fuelled engine exploded on his test bench in Berlin, killing him instantly.
- Perillos of Athens (circa 550 BCE), according to legend, was the first to be roasted in the brazen bull he made for Phalaris of Sicily for executing criminals.
- Li Si (208 BCE), Prime Minister during the Qin dynasty, was executed by the Five Pains method which some sources claim he had devised. However the history of the Five Pains is traced further back in time than Li Si.
- Wan Hu, a possibly-apocryphal 16th-century Chinese official, is said to have attempted to launch himself into outer space in a chair to which 47 rockets were attached. The rockets exploded, and it is said that neither he nor the chair were ever seen again.
- William Brodie, "Deacon Brodie" of 18th century Edinburgh is reputed to have been the first victim of a new type of gallows that he was also the designer and builder of, but this is doubtful.
- Jimi Heselden, a British entrepreneur who died in 2010 from injuries apparently sustained falling from a cliff while riding his own product, the Segway personal transport system.

List of famous experiments

- Eratosthenes evaluates the circumference of the earth with the distance between Alexandria and a place where the sun is directly overhead at midday (240 BC)
- Galileo Galilei uses a telescope to observe that the moons of Jupiter appear to circle Jupiter. This evidence supports the heliocentric model, and weakens the geocentric model of the cosmos (1609)
- Ole Rømer makes the first quantitative estimate of the speed of light in 1676 by timing the motions of Jupiter's satellite Io with a telescope.
- Kerim Kerimov launches Kosmos 186 and Kosmos 188 as experiments on automatic docking eventually leading to the development of space stations (1967).
- The Supernova Cosmology Project and the High-Z Supernova Search Team discover, by observing Type Ia supernovae, that the expansion of the Universe is accelerating (1998).
- Robert Hooke, using a microscope, observes cells (1665).
- Anton van Leeuwenhoek discovers microorganisms (1674–1676).
- James Lind, publishes 'A Treatise of the Scurvy' which describes a controlled ship board experiment using two identical populations but with only one variable, the consumption of citrus fruit (1753).
- Edward Jenner tests his hypothesis for the protective action of mild cowpox infection for smallpox, the first vaccine (1796).
- Gregor Mendel's experiments with the garden pea led him to surmise many of the fundamental laws of genetics (dominant vs recessive genes, the 1:2:1 ratio, see Mendelian inheritance) (1856–1863).
- Charles Darwin demonstrates evolution by natural selection using many examples (1859).
- Louis Pasteur uses S-shaped flasks to prevent spores from contaminating broth. This disproves the theory of Spontaneous generation (1861) extending the rancid meat experiment of Francesco Redi (1668) to the micro scale.
- Charles Darwin and his son Francis, using dark-grown oat seedlings, discover the stimulus for phototropism is detected at the tip of the shoot (the coleoptile tip), but the bending takes place in the region below the tip (1880).
- Emil von Behring and Kitasato Shibasaburō demonstrate passive immunity, protection of animals from infection by injection of immune serum (1890).
- Thomas Hunt Morgan identifies a sex chromosome linked gene in Drosophila melanogaster (1910) and his student Alfred Sturtevant develops the first genetic map (1913).
- Alexander Fleming demonstrates that the zone of inhibition around a growth of penicillin mould on a culture dish of bacteria is caused by a diffusible substance secreted by the mould (1928).
- Frederick Griffith demonstrates (Griffith's experiment) that living cells can be transformed via a transforming principle, later discovered to be DNA (1928).
- Karl von Frisch decodes the waggle dance honey bees use to communicate the location of flowers (1940).
- George Wells Beadle and Edward Lawrie Tatum moot the "one gene-one enzyme hypothesis" based on induced mutations in bread mold Neurospora crassa (1941).
- Luria–Delbrück experiment demonstrates that in bacteria, beneficial mutations arise in the absence of selection, rather than being a response to selection (1943).
- Barbara McClintock breeds maize plants for color, which leads to the discovery of transposable elements or jumping genes (1944).
- Linus Pauling and colleagues show in "Sickle Cell Anemia, a Molecular Disease" that a human genetic disease, sickle cell anemia, is caused by a molecular change in a specific protein, hemoglobin (1949).
- Hershey–Chase experiment (by Alfred Hershey and Martha Chase) uses bacteriophage to prove that DNA is the hereditary material (1952).
- Meselson–Stahl experiment proves that DNA replication is semiconservative (1958).
- Crick, Brenner et al. experiment using frameshift mutations to support the triplet nature of the genetic code (1961).
- John Gurdon clones an animal, a frog tadpole, from an egg cell using the nucleus from an intestinal cell (1962).
- Roger W. Sperry shows the potential independence of the two sides of the human brain using split-brain patients (1962–1965).
- Nirenberg and Leder experiment, binding tRNA to ribosomes with synthetic RNA to decipher the genetic code (1964).
- Demonstration of the role of reverse transcriptases in tumor viruses, independently by Howard Temin and David Baltimore, 1970.
- Mary-Dell Chilton shows that crown gall tumors of plants are caused by the transfer of a small piece of DNA from the bacterium Agrobacterium tumefaciens into the host plant, where it becomes part of its genome (1977).
- Blaise Pascal carries a barometer up a church tower and a mountain to determine that atmospheric pressure is due to a column of air (1648).
- Robert Boyle uses an air pump to determine the inverse relationship between the pressure and volume of a gas. This relationship came to be known as Boyle's law (1660–1662).
- Joseph Priestley suspends a bowl of water above a beer vat at a brewery and synthesizes carbonated water (1767).
- Antoine Lavoisier determines that oxygen combines with materials upon combustion, thus disproving phlogiston theory (1783).
- Antoine Lavoisier determines that chemical reactions in a closed container do not alter total mass. From these observations he establishes the law of conservation of mass (1789).
- Benjamin Thompson, Count Rumford demonstrates that the heat developed by the friction of boring cannon is nearly inexhaustible. This result was presented in opposition to caloric theory (1798).
- Humphry Davy uses electrolysis to isolate elemental potassium, sodium, calcium, strontium, barium, magnesium, and chlorine (1807–1810).
- Joseph Louis Gay-Lussac studies reactions among gases and determines that their volumes combine chemically in simple integer ratios (1809).
- Robert Brown studies very small particles in water under the microscope and observes Brownian motion which was later named in his honor (1827).
- Friedrich Wöhler synthesizes the organic compound urea using inorganic reactants, disproving the application of vitalism to chemical processes (1828).
- Thomas Graham measures the rates of effusion for different gases and establishes Graham's law of effusion and diffusion (1833).
- Julius Robert von Mayer and James Prescott Joule measure the heat generated by mechanical work. This establishes the principle of conservation of energy and the kinetic theory of heat (1842–1843).
- Louis Pasteur separates a racemic mixture of two enantiomers by sorting individual crystals, and demonstrates their impact on the polarization of light (1849).
- Anders Jonas Ångström observes the presence of hydrogen and other elements in the spectrum of the sun (1862).
- François-Marie Raoult demonstrates that the decrease in the vapor pressure and freezing point of liquids caused by the addition of solutes is proportional to the number of solute molecules present. This establishes the concept of colligative properties (1878).
- Svante Arrhenius studies the conductivity of salt solutions and determines that salts dissociate into ions in water (1884).
- Svante Arrhenius determines the impact of temperature on reaction rates and formulates the concept of activation energy (1889).
- William Ramsay and Lord Rayleigh (John Strutt) isolate the noble gases (1894–1898).
- Henri Becquerel, Marie Curie, and Pierre Curie discover radioactivity and describe its properties (1896).
- Mikhail Tsvet (Mikhail Semyonovich Tsvet) separates chlorophyll from other plant pigments using chromatography (1901).
- Frederick Soddy and William Ramsay observe the production of helium from alpha particles during radioactive decay (1903).
- Ernest Rutherford discovers that atoms have a very small positively charged nucleus in the gold-foil experiment, also known as the Geiger–Marsden experiment (1909).
- Otto Hahn discovers nuclear isomerism (1921).
- Albert Szent-Györgyi and Hans Adolf Krebs discover the citric acid cycle of oxidative metabolism (1935-1937).
- Otto Hahn and Fritz Strassmann discover the nuclear fission of uranium (1938).
- Glenn Theodore Seaborg and colleagues create and isolate five transuranium elements. They reorganize the periodic table to its current form. (1941–1950).
- Miller–Urey experiment demonstrates that organic compounds can arise spontaneously from inorganic ones (1953).
- Erwin Chargaff disproves the "tetranucleoide theory" of DNA structure and determines that the composition of double-stranded DNA follows the rule, %A = %T and %G = %C (Chargaff's rule). This discovery was critical to the formulation of the Watson-Crick Model of DNA structure.
- Neil Bartlett mixes xenon and platinum hexafluoride leading to the first synthesis of a noble gas compound, xenon hexafluoroplatinate (1962).
- Robert Burns Woodward announces the total synthesis of Vitamin B-12 by a team he led (1973). Insights from this work lead him and Roald Hoffmann to formulate the Woodward–Hoffmann rules for elucidating the stereochemistry of the products of organic reactions.
- Frederick Sanger demonstrates the dideoxy- or chain termination method for determining DNA sequences (1975).
- Kary Mullis demonstrates the polymerase chain reaction, a method for amplifying specific bits of DNA (1983).
- The experiments of Muhammad Yunus on the applications of microcredit and microfinance in rural Bangladesh (1971)
• Charles Mason conducts an experiment near the Scottish mountain of Schiehallion that attempts to measure the mean density of the Earth for the first time. Known as the Schiehallion experiment (1774)
• Galileo Galilei uses rolling balls to disprove the Aristotelian theory of motion (1602–07)
• Otto von Guericke demonstrates atmospheric pressure using Magdeburg hemispheres (1654)
• Robert Boyle shows that the volume of a given amount of gas is inversely related to the pressure upon it (1660)
• Benjamin Franklin beginning in 1747 describes experiments in letters to Peter Collinson demonstrating electrical principles which were published in a book called Experiments and Observations on Electricity.
• Alessandro Volta constructs a new source of electricity, the electrical battery (1796)
• Henry Cavendish’s torsion bar experiment measures the force of gravity in a laboratory (1798)
• Thomas Young shows that light is a wave in his double-slit experiment (c. 1805), extended in the 20th century to show it is a particle at the same time
• Observation of the Arago spot by François Arago in 1819 validated a new wave theory of light by Augustin-Jean Fresnel disproving skeptics like Siméon Denis Poisson.
• Hans Christian Ørsted discovers the connection of electricity and magnetism by experiments involving a compass and electric circuits (1820)
• Michael Faraday discovers magnetic induction in an experiment with a closed ring of soft iron, with two windings of wire (1831)
• James Prescott Joule demonstrates the mechanical equivalent of heat, an important step in the development of thermodynamics (1834)
• Christian Doppler arranges to have trumpets played from a passing train. The ground-observed pitch was higher than that played when the train was approaching then lower than that played as the train passed and moved away, demonstrating the Doppler effect (1845)
• Léon Foucault's namesake Foucault pendulum is first exhibited. It demonstrates the Coriolis effect and the rotation of the Earth (1851)
• Edwin Hall discovers a voltage across a conductor with a transverse applied magnetic field, the Hall effect (1879)
• Michelson–Morley experiment exposes weaknesses of the prevailing variant of the theory of luminiferous aether (1887)
• Heinrich Hertz demonstrates free space electromagnetic waves, predicted by Maxwell's equations, with a simple dipole antenna and spark gap oscillator (1887)
• Guglielmo Marconi demonstrates that radio signals can travel between two points separated by an obstacle. Marconi's servant is behind a hill 3 kilometers away and fires his rifle upon receiving the signals (1895).
• J. J. Thomson's cathode ray tube experiments (discovers the electron and its negative charge) (1897)
• Loránd Eötvös publishes the result of the second series of experiments, clearly demonstrating that inertial and gravitational mass are one and the same. (1909)
• Robert Millikan's oil-drop experiment, which suggests that electric charge occurs as quanta (whole units), (1909)
• Heike Kamerlingh Onnes demonstrates superconductivity (1911)
• Ernest Rutherford's gold foil experiment demonstrated that the positive charge and mass of an atom is concentrated in a small, central atomic nucleus, disproving the then-popular plum pudding model of the atom (1911)
• Arthur Eddington leads an expedition to the island of Principe to observe a total solar eclipse (gravitational lensing) - see Eddington experiment. This allows for an observation of the bending of starlight under gravity, a prediction of Albert Einstein's theory of relativity. It was confirmed (although it was later shown that the margin of error was as great as the observed bending) (1919)
• Otto Stern and Walther Gerlach conduct the Stern–Gerlach experiment, which demonstrates particle spin (1920)
• Enrico Fermi and his team in Rome achieved a nuclear reaction (1934, although the results were not understood until 1938, when nuclear fission was discovered by Otto Hahn and Fritz Strassmann)
• Enrico Fermi and Leó Szilárd build the first critical nuclear reactor (1942)
• John Bardeen and Walter Brattain fabricate the first working transistor (1947)
• Chien-Shiung Wu leads the team that disproves the conservation of parity in the Wu experiment (1956)
• Clyde L. Cowan and Frederick Reines confirm the existence of the neutrino in the neutrino experiment (1955)
• The Scout rocket experiment confirms the time dilation effect of gravity. (1976)
• Alain Aspect performs the Bell test experiments in the 1980s.
• Eric A. Cornell and Carl E. Wieman synthesize Bose–Einstein condensate at the University of Colorado at Boulder (1995)
• Cockcroft–Walton generator: The Cockcroft–Walton (CW) generator, or multiplier, is an electric circuit that generates a high DC voltage from a low-voltage AC or pulsing DC input. It was named after the British and Irish physicists John Douglas Cockcroft and Ernest Thomas Sinton Walton, who in 1932 used this circuit design to power their particle accelerator, performing the first artificial nuclear disintegration in history.
• Ivan Pavlov's experiments with dogs and classical conditioning (1900s)
- John B. Watson and Rosalie Rayner conduct the Little Albert experiment showing evidence of classical conditioning (1920)
- The Asch conformity experiments shows how group pressure can persuade an individual to conform to an obviously wrong opinion (1951)
- B. F. Skinner's demonstrations of operant conditioning (1930s–1960s)
- Harry Harlow's experiments with baby monkeys and wire and cloth surrogate mothers (1957–1974)
- Stanley Milgram's experiments on human obedience (1963)
- Walter Mischel's marshmallow experiment showing the importance to life outcomes of the ability to delay gratification (beginning late 1960s)
- Philip Zimbardo's Stanford prison experiment (1971)
- Allan and Beatrix Gardner's attempts to teach American Sign Language to the chimpanzee Washoe (1970s)
- Martin Seligman studies learned helplessness in dogs (1970s)
- Rosenhan experiment (1972). It involved the use of healthy associates or "pseudopatients", who briefly simulated auditory hallucinations in an attempt to gain admission to 12 different psychiatric hospitals. The hospital staff failed to detect a single pseudopatient. The study is considered an important and influential criticism of psychiatric diagnosis.
- Kansas City preventive patrol experiment (1972–1973) It was designed to test the assumption that the presence (or potential presence) of police officers in marked cars reduced the likelihood of a crime being committed. No relationship was found.
- Elizabeth Loftus' and John C. Palmer's car crash experiment shows that leading questions can produce false memories (1974)
- Benjamin Libet's experiment on free will shows that a readiness potential appears before the notion of doing the task enters conscious experience, sparking debate about the illusory nature of free will yet again. (1983)
- Vilayanur S. Ramachandran's experiment on phantom limbs with the Mirror Box throw light on the nature of 'learned paralysis' (1998)

List of Russian mathematicians

- **Georgy Adelson-Velsky**, inventor of AVL tree algorithm, developer of Kaissa, the first world computer chess champion
- **Sergei Adian**, known for his work in group theory, especially on the Burnside problem
- **Aleksandr Aleksandrov**, developer of CAT(k) space and Alexandrov's uniqueness theorem in geometry
- **Pavel Alexandrov**, author of the Alexandroff compactification and the Alexandrov topology
- **Dmitri Anosov**, developed Anosov diffeomorphism
- **Vladimir Arnold**, an author of the Kolmogorov–Arnold–Moser theorem in dynamical systems, solved Hilbert's 13th problem, raised the ADE classification and Arnold's rouble problems
- **Sergey Bernstein**, developed the Bernstein polynomial, Bernstein's theorem and Bernstein inequalities in probability theory
- **Nikolay Bogolyubov**, mathematician and theoretical physicist, author of the edge-of-the-wedge theorem, Krylov–Bogolyubov theorem, describing function and multiple important contributions to quantum mechanics
- **Vladimir Berkovich**, developed Berkovich spaces
- **Viktor Bunyakovsky**, noted for his work in theoretical mechanics and number theory, and is credited with an early discovery of the Cauchy–Schwarz inequality
- **Leonid Berlyand**, PDE theorist, worked on asymptotic homogenization methods
- **Georg Cantor**, inventor of set theory. Cantor was born into the Russian Empire, moving to Saxony with his family at age 11.
- **Sergey Chaplygin**, author of Chaplygin's equation important in aerodynamics and notion of Chaplygin gas.
- **Nikolai Chebotaryov**, author of Chebotarev's density theorem
- **Pafnuti Chebyshev**, prominent tutor and founding father of Russian mathematics, contributed to probability, statistics and number theory, author of the Chebyshev's inequality, Chebyshev distance, Chebyshev function, Chebyshev equation etc.
- **Sergei Chernikov**, a significant contributor to both infinite group theory (developer of Chernikov groups), and linear programming.
- **Boris Delaunay**, inventor of Delaunay triangulation, organised the first Soviet Student Olympiad in mathematics
- **Vladimir Drinfeld**, mathematician and theoretical physicist, introduced quantum groups and ADHM construction, Fields Medal winner
- **Eugene Dynkin**, developed Dynkin diagram, Doob–Dynkin lemma and Dynkin system in algebra and probability
- **Dmitri Egorov**, known for significant contributions to the areas of differential geometry and mathematical analysis.
• **Leonhard Euler**, preeminent 18th century mathematician, arguably the greatest of all time, made important discoveries in mathematical analysis, graph theory and number theory, introduced much of the modern mathematical terminology and notation (mathematical function, Euler’s number, Euler circles etc.). Although Swiss born Euler spent most of his life in St. Petersburg

• **Ivan Fesenko**, number theorist

• **Anatoly Fomenko**, topologist and chronologist, put forth a controversial theory of the New Chronology

• **Yevgraf Fyodorov**, mathematician and crystallographer, identified Periodic graph in geometry, the first to catalogue all of the 230 space groups of crystals

• **Boris Galerkin**, developed the Galerkin method in numerical analysis

• **Israel Gelfand**, major contributor to numerous areas of mathematics, including group theory, representation theory and linear algebra, author of the Gelfand representation, Gelfand pair, Gelfand triple, integral geometry etc.

• **Alexander Gelfond**, author of Gelfond's theorem, provided means to obtain infinite number of transcendals, including Gelfond–Schneider constant and Gelfond's constant, Wolf Prize in Mathematics winner

• **Semyon Aranovich Gershgorin**, of Gerschgorin circle theorem fame

• **Sergei Godunov**, developed Godunov's theorem and Godunov's scheme in differential equations

• **Valery Goppa**, inventor of Goppa codes in algebraic geometry

• **Mikhail Gromov**, a prominent developer of geometric group theory, inventor of homotopy principle, introduced Gromov's compactness theorem, Gromov norm, Gromov product etc., Wolf Prize winner

• **Leonid Kantorovich**, mathematician and economist, founded linear programming, introduced the Kantorovich inequality and Kantorovich metric, developed the theory of optimal allocation of resources, Nobel Prize in Economics winner

• **Anatoly Karatsuba**, developed the Karatsuba algorithm (the first fast multiplication algorithm)

• **Leonid Khachiyan**, developed the Ellipsoid algorithm for linear programming

• **Aleksandr Khinchin**, developed the Pollaczek-Khinchine formula, Wiener–Khinchin theorem and Khinchin inequality in probability theory

• **Askold Khovanskii**, inventor of the theory of Fewnomials, contributions to the theory of toric varieties, Jeffery–Williams Prize winner

• **Andrey Kolmogorov**, a preeminent 20th century mathematician, Wolf Prize winner; multiple contributions to mathematics include: probability axioms, Chapman–Kolmogorov equation and Kolmogorov extension theorem in probability; Kolmogorov complexity etc.
- **Maxim Kontsevich**, author of the Kontsevich integral and Kontsevich quantization formula, Fields Medal winner
- **Aleksandr Korkin**, made contribution to the development of partial differential equations
- **Vladimir Kotelnikov**, a pioneer in information theory, an author of fundamental sampling theorem
- **Sofia Kovalevskaya**, the first woman professor in Northern Europe and Russia, the first female professor of mathematics, discovered the Kovalevskaya top
- **Mikhail Kravchuk**, developed the Kravchuk polynomials and Kravchuk matrix
- **Mark Krein**, developed the Tannaka–Krein duality, Krein–Milman theorem and Krein space, Wolf Prize winner
- **Alexander Kronrod**, developer of Gauss–Kronrod quadrature formula and Kaissa, the first world computer chess champion
- **Aleksey Nikolaevich Krylov**, first developed the method of Krylov subspace, still widely used numerical method for linear problems
- **Nikolay Krylov**, author of the edge-of-the-wedge theorem, Krylov–Bogolyubov theorem and describing function
- **Aleksandr Kurosh**, author of the Kurosh subgroup theorem and Kurosh problem in group theory
- **Olga Ladyzhenskaya**, made major contributions to solution of Hilbert's 19th problem and important Navier–Stokes equations
- **Evgeny Landis**, inventor of AVL tree algorithm
- **Vladimir Levenshtein**, developed the Levenshtein automaton, Levenshtein coding and Levenshtein distance
- **Leonid Levin**, computer scientist, developed the Cook-Levin theorem
- **Yuri Linnik**, developed Linnik's theorem in analytic number theory
- **Nikolai Lobachevsky**, a *Copernicus of Geometry* who created the first non-Euclidean geometry (Lobachevskian or hyperbolic geometry)
- **Nikolai Lusin**, developed Luzin's theorem, Luzin spaces and Luzin sets in descriptive set theory
- **Aleksandr Lyapunov**, founder of stability theory, author of the Lyapunov's central limit theorem, Lyapunov equation, Lyapunov fractal, Lyapunov time etc.
- **Leonty Magnitsky**, a director of the Moscow School of Mathematics and Navigation, author of the principal Russian 18th century textbook in mathematics
- **Anatoly Maltsev**, researched decidability of various algebraic groups, developed the Malcev algebra
- **Yuri Manin**, author of the Gauss–Manin connection in algebraic geometry, Manin-Mumford conjecture and Manin obstruction in diophantine geometry
- **Grigory Margulis**, worked on lattices in Lie groups, Wolf Prize and Fields Medal winner
- **Andrey Markov, Sr.**, invented the Markov chains, proved Markov brothers' inequality, author of the hidden Markov model, Markov number, Markov property, Markov's inequality, Markov processes, Markov random field, Markov algorithm etc.
- **Andrey Markov, Jr.**, author of Markov's principle and Markov's rule in logics
- **Yuri Matiyasevich**, author of Matiyasevich's theorem in set theory, provided a negative solution for Hilbert's tenth problem
- **Mikhail Menshikov**, probabilist
- **Alexander Mikhailov**, coined the term Informatics
- **Mark Naimark**, author of the Gelfand–Naimark theorem and Naimark's problem
- **Pyotr Novikov**, solved the word problem for groups and Burnside's problem
- **Sergei Novikov**, worked on algebraic topology and soliton theory, developed Adams–Novikov spectral sequence and Novikov conjecture, Wolf Prize and Fields Medal winner
- **Andrei Okounkov**, infinite symmetric groups and Hilbert scheme researcher, Fields Medal winner
- **Mikhail Ostrogradsky**, mathematician and physicist, author of divergence theorem and partial fractions in integration
- **Grigori Perelman**, made landmark contributions to Riemannian geometry and topology, proved Geometrization conjecture and Poincaré conjecture, won a Fields medal and the first Clay Millennium Prize Problems Award (declined both)
- **Lev Pontryagin**, blind mathematician, developed Pontryagin duality and Pontryagin classes in topology, and Pontryagin's minimum principle in optimal control
- **Yury Prokhorov**, author of the Lévy–Prokhorov metric and Prokhorov's theorem in probability
- **Alexander Razborov**, mathematician and computational theorist who won the Nevanlinna Prize in 1990 and the Gödel Prize for contributions to computer sciences
- **Lev Schnirelmann**, developed the Lusternik–Schnirelmann category in topology and Schnirelmann density of numbers
- **Moses Schönfinkel**, inventor of combinatory logic
- **Yakov Sinai**, developed the Kolmogorov–Sinai entropy and Sinai billiard, Wolf Prize winner
- **Eugen Slutsky**, statistician and economist, developed the Slutsky equation and Slutsky's theorem
- **Stanislav Smirnov**, prominent researcher of triangular lattice, Fields Medalist
• Sergei Sobolev, introduced the Sobolev spaces and mathematical distributions, co-developer of the first ternary computer Setun

• Vladimir Steklov, mathematician and physicist, founder of Steklov Institute of Mathematics, proved theorems on generalized Fourier series

• Bella Subbotovskaya, specialist in Boolean functions, founder of unauthorized Jewish People's University to educate Jews barred from quality universities

• Jakow Trachtenberg, developed the Trachtenberg system of mental calculation

• Boris Trakhtenbrot, proved the Gap theorem, developed Trakhtenbrot's theorem

• Valentin Turchin, inventor of Refal programming language, introduced metasystem transition and supercompilation

• Andrey Tikhonov, author of Tikhonov space and Tikhonov's theorem (central in general topology), the Tikhonov regularization of ill-posed problems, invented magnetotellurics

• Pavel Urysohn, developed the metrization theorems, Urysohn's Lemma and Fréchet–Urysohn space in topology

• Nicolay Vasilyev, inventor of non-Aristotelian logic, the forerunner of paraconsistent and multi-valued logics

• Ivan Vinogradov, developed Vinogradov's theorem and Pólya–Vinogradov inequality in analytic number theory

• Vladimir Voevodsky, introduced a homotopy theory for schemes and modern motivic cohomology, Fields Medalist

• Georgy Voronoy, invented the Voronoi diagram

• Dmitry Yegorov, author of Egorov's Theorem in mathematical analysis

• Efim Zelmanov, solved the restricted Burnside problem; Fields Medal winner

List of German inventors and discoverers

• Ernst Abbe: Invented the first refractometer, and many other devices. Donated his shares in the company Carl Zeiss to form Carl-Zeiss-Stiftung, still in existence today.

• Franz Carl Achard: Developed a process to produce sugar from sugar beet. Built the first factory for the process in 1802.

• Robert Adler: Invented a better television remote control.
- Konrad Adenauer: Invented soya sausage (1916; "Kölner Wurst") and, together with Jean and Josef Oebel, [coarse] wholemeal bread (1917; Kölner Brot).
- Georgius Agricola: Named "the father of mineralogy".
- Wilhelm Albert: Invented the wire rope 1834.
- Richard Altmann: Discovery of the Mitochondrion
- Momme Andresen (1857-1951): industrial research chemist who made inventions relating to photography
- Ottomar Anschütz: in 1883 he patented a camera with an internal roller blind shutter mechanism, just in front of the photographic plate. Thus the focal-plane shutter in modern recognizable form was born.
- Hermann Anschütz-Kaempfe: Invented the gyrocompass in 1907.
- Manfred von Ardenne: Self-taught researcher, applied physicist and inventor. 600 patents in fields including television and radio, electron microscopy, medical technology, nuclear technology, and plasma physics.
- Friedrich Wilhelm August Argelander: catalogued all stars brighter than approximately magnitude 9.5 and north of -2 degrees in the Bonner Durchmusterung, the first large-scale modern star catalogue.
- Leo Arons: Mercury-vapor lamp together with Peter Cooper Hewitt.
- Leopold Auerbach: Discovery of Plexus myentericus Auerbachi, or Auerbach's plexus.
- Max Abraham: Physicist. Worked as Max Planck's assistant for three years. Developed theories on electrons.
- Walter Baade: astronomer. With Fritz Zwicky, he identified supernovae as a new category of astronomical objects
- Karl Ernst von Baer: discovered mammal ovum.
- Ralph Baer: Inventor of the first home video game console.
- Adolf von Baeyer: Chemist. Synthesized indigo, discovered the phthalein dyes, and investigated polyacetylenes, oxonium salts, nitroso compounds (1869) and uric acid derivatives (1860 and onwards) including the discovery of barbituric acid (1864). Nobel laureate 1905.
- Albert Ballin: Father of modern cruise ship travel
- Heinrich Band: Developed a musical instrument and called it bandoneón in 1846. It is still used in most tango orchestras.
• Heinrich Barkhausen: Discovered what is now called the Barkhausen effect, to describe the phenomenon, which is caused by rapid changes of size of magnetic domains in 1919, and Barkhausen stability criterion.

• Oskar Barnack: The father of the first mass marketed 35mm camera and Leica.

• Heinrich Anton de Bary: Father of Phytopathology, the science of plant diseases and modern Mycology. Coined the word symbiosis in 1879.

• Karl Adolph von Basedow: Discovery and description of Graves-Basedow disease

• Andreas Friedrich Bauer: first functional steam-powered printing press with his colleague Friedrich Koenig

• Wilhelm Bauer: Inventor and engineer, who built several hand-powered submarines.

• Eugen Baumann: He was one of the first people to create polyvinyl chloride (PVC), and, together with Carl Schottten, he discovered the Schottten-Baumann reaction.

• Carl Baunscheidt: Inventor of the Lebenswecker ("life awakener") or "artificial leech".

• Hans Beck: Inventor of the toy Playmobil.

• Georg Bednorz: Physicist, discovered high-temperature superconductivity in ceramics, shared the 1987 Nobel Prize in Physics.

• Martin Behaim: Inventor of the first globe of the world (Erdapfel) between 1491 and 1493.

• Alexander Behm: Inventor of echo sounding. The patent was granted in 1913.

• Emil von Behring: Discovery of diphtheria antitoxin

• Fabian Gottlieb von Bellingshausen: Navigator and explorer. Discovered the land mass of Antarctica on January 28, 1820.

• Friedrich Bessel: astronomer; he is credited with being the first to use parallax in calculating the distance to a star.

• Hans Bethe: Nuclear physicist and Nobel laureate in physics 1967. During World War II, he was head of the Theoretical Division at the secret Los Alamos laboratory which developed the first atomic bombs.

• Emil Adolf von Behring: physiologist. Discovered the diphtheria antitoxin. It was the world's first cure for a disease (1891). He was awarded history's first Nobel Prize in Physiology of Medicine in 1901.

• Melitta Bentz: entrepreneur. She is an inventor of the coffee filter, 1908.

• Karl Benz: industrialist. Father and inventor of the gasoline-powered automobile, 1885, and pioneering founder of automobile manufacturing.

• Albrecht Berblinger: engineer. Inventor of the spring prosthesis and hang-glider (1811).

• Hans Berger: a German neurologist, best known as the inventor of electroencephalography (EEG) (the recording of "brain waves") in 1924, coining the name, and the discoverer of the alpha wave rhythm known as "Berger's wave"
• Emil Berliner: He is best known for developing the microphone and disc recording gramophone.
• Albert Betz: physicist. Betz's law, 1913
• Friedrich Bessel: astronomer, he is credited with being the first to use parallax in calculating the distance to a star.
• Heinz Billing: Computer scientist. He invented the magnetic drum memory and built prototype laser interferometric gravitational wave detector in Garching, Munich.
• Otto von Bismarck: Under his reign, the German Empire (1871–1918) became the first modern welfare state in the world, when he e.g. innovatively implemented the following: health insurance (1883), accident insurance (1884), pension insurance (1889).
• Ludwig Blattner: developed the Blattnerphone, the first magnetic tape recorder (using steel tape) whilst working in Britain in the late 1920s.
• Günter Blobel: biologist, discovered signal peptides. Nobel Prize in Physiology or Medicine in 1999.
• Walter Bock: chemist, Styrene-butadiene
• Max Bockmühl: chemist, he developed Methadone together with German Gustav Ehrhart in 1937 in Germany, working for I.G. Farbenindustrie AG at the Farbwerke Hoechst
• Johann Elert Bode: astronomer, Discovered the Titus-Bode Law
• Ludwig Bölkow: Aeronautical pioneer. Was instrumental in the development of the Me 262, developed a new rotorhead concept for helicopters.
• Max Born: Physicist and mathematician. Groundbreaking work in quantum mechanics. Nobel laureate 1954 with Walther Bothe. His Ph.D. student Delbrück, and six of his assistants (Fermi, Heisenberg, Goeppert-Mayer, Herzberg, Pauli, Wigner) went on to win Nobel Prizes. His Ph.D. student J. Robert Oppenheimer led the project to develop the atomic bomb.
• Manfred Börner: Physicist. Developed the first working fiber-optical data transmission system in 1965. Received a patent for an "electro-optical transmission system utilizing lasers".
• Carl Bosch: Chemist and Nobel laureate, discovered the processes of industrial high pressure chemistry.
• Robert Bosch: industrialist, engineer. He invented, engineered and launched various innovations for the motor vehicle.
• Walther Bothe: Nuclear physicist, who shared the Nobel Prize in Physics in 1954 with Max Born.
• Johann Friedrich Böttger: alchemist. He was generally acknowledged as the inventor of European porcelain although more recent sources ascribe this to Ehrenfried Walther von Tschirnhaus. Böttger is still credited with developing the manufacture of porcelain in Europe.
• Theodor Boveri: biologist, described Centrosome.
• Karlheinz Brandenburg: Inventor and audio engineer; father of audio compression format MPEG Audio Layer 3, more commonly known as MP3.
• Karl Ferdinand Braun: Inventor of the CRT oscilloscope in 1897. Braun contributed significantly to the development of radio and television technology: he shared with Guglielmo Marconi the 1909 Nobel Prize in Physics.
• Wernher von Braun: The preeminent rocket engineer of the 20th century. Developed the V-2 rocket for Germany. Built Saturn V rocket in USA which put man on the moon.
• Adolf Brix: developed the unit for specific gravity of liquids, degree Brix (°Bx).
• Korbinian Brodmann: neurologist, Brodmann area in brain
• Walter Bruch: PAL, colour encoding system for analogue television
• Friedrich Wilhelm Gustav Bruhn: Inventor of Taximeter
• Ernst Büchner: Chemist and inventor of Büchner flask and Büchner funnel.
• Robert Bunsen: Chemist who developed the Bunsen burner, and with Gustav Kirchhoff he invented the spectrometer (1859) and discovered caesium (1860) and rubidium (1861).
• Wilhelm Busch: Caricaturist, painter and poet; father of comics.
• Christian Friedrich Ludwig Buschmann: musical instrument maker. Pioneer and promoter of the harmonica.
• Adolf Busemann: aerospace engineer. Discovered the effect of swept wing for modern aircraft in 1935.
• Adolf Butenandt: biochemist. Discovered primary female sex hormones. Shared the Nobel Prize in Chemistry with Leopold Ruzicka in 1939.
• Heinrich Wilhelm Brandes: Founder of synoptic meteorology. As an astronomer, he was noted for demonstrating that meteors occur in the upper atmosphere and thus not really a meteorological phenomenon.
• Karl Friedrich Bonhoeffer: German chemist, who, together with Paul Harteck, discovered the spin isomers of hydrogen, orthohydrogen and parahydrogen in 1929.
• Georg Cantor: Mathematician, discoverer of the set theory (1870s), which has become a fundamental theory in mathematics.
• Ernst Boris Chain: biochemist, co-recipient of the Nobel Prize for Physiology or Medicine for his work on penicillin (together with Fleming).
• Carl von Clausewitz: The father of modern military theory.
• Rudolf Clausius: Mathematician and physicist known for the Second law of thermodynamics.
• Justus Claproth: Jurist and inventor of recyclable paper and deinking.
• Nicolaus Copernicus: Astronomer, formulated a heliocentric model of the universe which placed the Sun, rather than the Earth, at the centre.

• Manfred Curry: German American yachtsman, developed the cam cleat used on sailboats to easily and quickly secure a rope, discoverer of the pseudoscientific phenomenon of "geomagnetic lines" called the Curry Grid.

• Gottlieb Daimler: Invented the first high-speed internal combustion petrol engine and the first four-wheel automobile, also the first internal combustion motorcycle, the Reitwagen.

• Adolf "Adi" Dassler: Sports shoes with and without spikes; founder of Adidas.

• Rudolf Dassler: First sport shoes with screw-in shoe spikes, 1949; founder of Puma.

• Hans Georg Dehmelt: Physicist. Co-developed the non-magnetic quadrupole mass filter which laid the foundation for what we now call an ion trap. Shared the Nobel Prize in 1989.

• Max Delbrück: German American biophysicist. He was awarded the Nobel prize for discovering that bacteria become resistant to viruses (phages) as a result of genetic mutations.

• Johann Christoph Denner: Woodwind instrument maker, inventor of the clarinet.

• Jürgen Dethloff: Inventor and engineer, co-inventor of the Smart card (together with Helmut Gröttrup).

• Johann Friedrich Dieffenbach: Pioneer of skin transplantation and cosmetic surgery.

• Ernst Dickmanns: Developer of the first driverless car.

• Otto Diels: Diels–Alder reaction (together with Kurt Alder), a method for diene synthesis. The pair was awarded the Nobel Prize in Chemistry in 1950 for their work.

• Rudolf Diesel: Inventor of the diesel engine 1893.

• Johann Wolfgang Döbereiner, inventor of Döbereiner's lamp, 1823

• Gerhard Domagk: Discovery of what would become the first commercially available antibiotic.

• Christian Doppler: Discovered the Doppler effect.

• Walter Robert Dornberger: Co-inventor of the V-2 rocket.

• Karl Drais: Inventor of the bicycle and typewriter (1821) among other things.

• Peter Ferdinand Drucker: Invented the science of modern management.

• Paul Ehrlich: Scientist in the fields of hematology, immunology, and chemotherapy, and Nobel laureate. Developed an effective treatment against syphilis.

• Albert Einstein: Theoretical physicist, key 20th century scientist and cultural icon.

• Ludwig Elsbett: Developed new concepts for Diesel engines which drastically enhanced efficiency.

• Douglas Engelbart: German American inventor of the computer mouse.
• Evaristo Conrado Engelberg: Inventor in 1885 of a machine used to remove the husks from rice and coffee, the Engelberg huller.

• Friedrich Engels: He invented together with Karl Marx the economic and sociopolitical worldview Marxism.

• Hugo Erdmann: Chemist who discovered, together with his doctoral advisor Jacob Volhard, the Volhard-Erdmann cyclization. In 1898 he was the first who coined the term noble gas (the original noun is Edelgas in German).

• Hugo Erfurt: Ingrain wallpaper

• Gerhard Ertl: German physicist who laid the foundation of modern surface chemistry, which has helped explain how fuel cells produce energy without pollution, how catalytic converters clean up car exhausts and even why iron rusts, the Royal Swedish Academy of Sciences said. Nobel laureate as of 2007.

• Leonhard Euler: Swiss mathematician and physicist. One of the most influential mathematicians of the 18th century.

• Emil Erlenmeyer: German chemist known for contributing to the early development of the theory of structure, formulating the Erlenmeyer rule, and designing the Erlenmeyer flask or the conical flask, a type of chemical flask, which is named after him.

• Daniel Gabriel Fahrenheit: Fahrenheit, temperature scale, Fahrenheit hydrometer

• Emil Faltling: Mathematician known for his work in arithmetic algebraic geometry, Fields Medal in 1986 for proving the Mordell conjecture.

• Otto Feick: Wheel gymnastics in 1925.

• Wilhelm Emil Fein: Invented the electrically-driven hand drill in 1895.

• Adolf Gaston Eugen Fick: Glass Contact lenses

• Richard Fiedler: Invented the modern flamethrower in 1901.

• Artur Fischer: Invented the (split) wallplug made of plastic in 1958. He invented flash light photography. Fischer held over 1100 patents and currently holds the records for most patents for any single human, even more than Thomas Alva Edison. Further inventions are (bone-)plugs for fixing bone fractures and one of Fischer's most recent inventions is a gadget that makes it possible to hold and cut the top off an egg of any size.

• Hermann Emil Fischer: German chemist and 1902 recipient of the Nobel Prize in Chemistry. He discovered the Fischer esterification. He developed the Fischer projection, a symbolic way of drawing asymmetric carbon atoms. He is known for study of sugars & purines.

• Franz Fischer and Hans Tropsch: Invented a process in 1925 to turn coal into synthesis gas, and still further into liquid hydrocarbons. The process is a key component in modern gas to liquids processes.
• Wilhelm Rudolph Fittig: He discovered the pinacol coupling reaction, mesitylene, diacetyl and biphenyl.

• Irmgard Flügge-Lotz: She worked on what she called "discontinuous automatic control", which laid the foundation for automatic on-off aircraft control systems in jets.

• Werner Forssmann: Performed the first human cardiac catheterisation. Shared the Nobel Prize for Medicine 1956

• Joachim Frank: co-invented cryo-electron microscopy. Shared the Nobel Prize for Chemistry 2017

• Joseph von Fraunhofer: Discovery of the dark absorption lines known as Fraunhofer lines in the Sun's spectrum, which laid foundation for modern astronomy and astrophysics, and for making excellent optical glass and achromatic telescope lenses.

• Gottlob Frege: He is generally considered to be the father of analytic philosophy. Had influence on Carnap, Russell, and Wittgenstein

• Otto Frenzl: Aeronautical pioneer, developed the area rule in 1943, a design technique for airfoils used to reduce an aircraft's drag at transonic and supersonic speeds. Later it was independently developed again by Richard T. Whitcomb in 1952.

• Sigmund Freud: Neurologist who became known as the founding father of psychoanalysis.

• Nikolaus Friedreich: Discovery of Friedreich-Auerbach disease (together with Leopold Auerbach)

• Friedrich Fröbel: Pedagogue, who laid the foundation for modern education. He created the concept of the kindergarten.

• Klaus Fuchs: Theoretical physicist involved with the Manhattan Project; at the same time Soviet spy.

• Johann Carl Fuhlrott: Had the insight to recognize the Neanderthal bones for what they were: the remains of a previously unknown type of humans. He (together with Schaafhausen) is considered to be the father of paleoanthropology.

• Johann Galle: astronomer, discovery of planet Neptune

• Hermann Ganswindt: Inventor and spaceflight scientist, whose inventions (such as the dirigible, the helicopter, and the internal combustion engine) are thought to have been ahead of his time.

• Johann Carl Friedrich Gauss: German mathematician and physical scientist who contributed significantly to many fields, including number theory, statistics, analysis, differential geometry, geodesy, geophysics, electrostatics, astronomy and optics. Sometimes referred to as "the Prince of Mathematicians".


• Heinrich Geißler: Inventor of the Geissler tube.
• Reinhard Genzel: Astrophysicist, he and his group were the first to track the motions of stars at the centre of the Milky Way and show that they were orbiting a very massive object, probably a supermassive black hole.

• Walter Gerlach: Physicist who co-discovered spin quantization in a magnetic field, the Stern–Gerlach effect.

• Edmund Germer: Inventor of the neon lamp (Neonlampe).

• Max Giese: Inventor of the first concrete pump in 1928.

• Heinrich Göbel: Inventor of Hemmer for Sewing Machines, 1865, Vacuum Pump (Improvement of the Geissler-System of vacuum pumps, 1881 and Electric Incandescent Lamp (sockets to connect the filament of carbon and the conducting wires), 1882.

• Kurt Gödel: Important discoveries in math and logic, such as the incompleteness theorems


• Konrad Grebe: Coal-machine (Kohlenhobel)

• Heinrich Greinacher: German-Swiss physicist. He is regarded as an original experimenter and is the developer of the magnetron and the Greinacher multiplier; Cockcroft-Walton-Generator in 1914.

• Brothers Grimm: Academic pioneers of philology, linguistics, and storytelling. Worked together on the most comprehensive dictionary of the German language Deutsches Wörterbuch. Jacob Grimm: Philologist and linguist. Described first what is now known as Grimm's law, the first scientific research into sound change in 1822.

• Georg Friedrich Grotefend: Deciphering of cuneiform

• Alexander Grothendieck: Mathematician and the central figure behind the creation of the modern theory of algebraic geometry; Fields Medalist (1966).

• Helmut Gröttrup: smart card (together with Jürgen Dethloff)


• Heinz Guderian: The father of modern mechanized warfare, inventor of the Blitzkrieg strategy.

• Otto von Guericke: Groundbreaking research into air pressure. Invented the vacuum pump in 1650.

• Beno Gutenberg: Together with American Charles Francis Richter he invented Richter magnitude scale.
- Johannes Gutenberg: Inventor of the technology of printing with movable type in 1439. The first book so printed was the Gutenberg Bible.

- Aristid von Grosse: He was able to isolate protactinium oxide and was later able to produce metallic protactinium by decomposition of protactinium iodide.

- Johann Rudolf Glauber: German-Dutch alchemist who was one of the first chemical engineers. His discovery of sodium sulfate in 1625 led to the compound being named after him: "Glauber's salt".

- Fritz Haber: German chemist and Nobel laureate who pioneered synthetic ammonia and chemical warfare.


- Otto Hahn: German chemist and Nobel laureate who pioneered the fields of radioactivity and radiochemistry. Considered to be "the father of nuclear chemistry" and the "founder of the atomic age". Discovered many isotopes, Protactinium and nuclear fission.

- Samuel Hahnemann: Physician, best known for creating a system of alternative medicine called homeopathy.

- Harald zur Hausen: Virologist, discovered the role of papilloma viruses in the development of cervical cancer. His research made the development of a vaccine against papilloma possible, which will drastically reduce cervical cancer in future. Nobel laureate as of 2008.

- Werner Heisenberg: Theoretical physicist who made fundamental contributions to quantum mechanics. Discovered a particle's position and velocity cannot be known at the same time. Discovered atomic nuclei are made of protons and neutrons.

- Wolfgang Helfrich: Co-inventor of Twisted nematic field effect.

- Rudolf Hell: Inventor of the first fax machine (Hellschreiber).

- Richard Hellmann: Hellmann's (Blue Ribbon) Mayonnaise, 1905.

- Hermann von Helmholtz: Discovered the principle of conservation of energy.

- Peter Henlein: Inventor of the portable watch.

- Friedrich Wilhelm Herschel (William Herschel): Discovered the planet Uranus and infrared radiation among other things.

- Heinrich Hertz: Physicist, Discoverer of electromagnetic/radio waves.

- Otto Herzog: First use of the Carabiner in mountain climbing which substantially enhanced security for mountaineers.

- Victor Francis Hess: Discovered Cosmic rays. Also won the Nobel Prize.

- David Hilbert: Influential mathematician who discovered and developed a broad range of fundamental ideas in math.
• Albert Hofmann: German-Swiss; Discovered the chemical properties of chitin and lysergic acid diethylamide.

• Wilhelm Hofmeister: Discovery of the Alternation of generations

• Felix Hoffmann: Isolated acetylsalicylic acid, a painkiller marketed under the name Aspirin (Bayer), 1897. In some English speaking countries marketed under the name disprin.

• Herman Hollerith: a German American statistician who developed a mechanical tabulator based on punched cards

• Gottlob Honold: Inventor of the spark plug and the modern internal combustion engine, as well as headlights.

• Horten brothers: Designed some of the most advanced aircraft of the 1930s and '40s, including the world's first jet-powered flying wing, the Horten Ho 229.

• Christian Hülsmeyer: German inventor of the Telemobilskop, a radio-based detector of remote objects; a 1904 precursor of radar.

• Alexander von Humboldt: Naturalist and explorer. His quantitative work on botanical geography was foundational to the field of biogeography.

• Wilhelm von Humboldt: Originator of the linguistic relativity hypothesis.

• Erich Huzenlaub: Huzenlaub Process for parboiling

• Johannes Heidenhain: Invented the Metallur process. This lead-sulfide copying process made it possible for the first time to make exact copies of an original grating on a metal surface for industrial use. By 1943, Heidenhain was producing linear scales with accuracy of ± 15 µm and circular scale disks with accuracy of ± 3 angular seconds.

• Karl Andreas Hofmann: German inorganic chemist who is best known for his discovery of a family of clathrates which consist of a 2-D metal cyanide sheet, with every second metal also bound axially to two other ligands. These materials have been named 'Hofmann clathrates' in his honour.

• Ernst Ising: physicist who developed Ising model.

• Otmar Issing: Economist who invented the "pepet pillar" decision algorithm now used by the ECB.

• J. Hans D. Jensen: Nuclear physicist, proposed the nuclear shell model, shared 1963 Nobel Prize in Physics.

• Hugo Junkers: Pioneer of all-metal aircraft construction with the Junkers J 1 (1915–16).

• Ferdinand Adolf Kehrer: Introduction of the transverse incision technique to minimize bleeding by modern Caesarean section

• Donald J. Kessler: Astrophysicist, known for developing the Kessler syndrome.

• Hermann Kemper: Invented the magnetic levitation train. Patent granted in 1934.
- Johannes Kepler: Discovered the laws of planetary motion.
- Erhard Kietz: Pioneer discoverer of video technology.
- Gustav Kirchhoff: Discovery of the principles upon which spectroscopy is founded. He contributed to the fundamental understanding of electrical circuits, spectroscopy, and the emission of black-body radiation by heated objects. He coined the term "black body" radiation in 1862, and two different sets of concepts (one in circuit theory, and one in spectroscopy) are named "Kirchhoff's laws" after him; there is also a Kirchhoff's Law in thermochemistry. The Bunsen–Kirchhoff Award for spectroscopy is named after him and his colleague, Robert Bunsen, who both invented the spectrometer in 1859.
- Martin Heinrich Klaproth: Discovered the element Uranium.
- Klaus von Klitzing: Physicist, known for discovery of the integer quantum Hall effect, 1985 Nobel Prize in Physics.
- Ludwig Knorr: Chemist, who together with Carl Paal, discovered the Paal-Knorr synthesis, and the Knorr quinoline synthesis and Knorr pyrrole synthesis.
- Robert Koch: Physician, discoverer, inventor and Nobel Prize winner. He became famous for isolating Bacillus anthracis (1877), the Tuberculosis bacillus (1882) and the Vibrio cholera (1883) and for his development of Koch's postulates.
- Friedrich Koenig: first functional steam-powered printing press with his colleague Andreas Friedrich Bauer)
- Alfred Körte and Gustav Körte: discovered Gordium, 1900
- Franz Kolb: Plasticine
- Arthur Korn: Inventor involved in development of the fax machine, specifically the transmission of photographs or telephotography, known as the Bildtelegraph.
- Albrecht Kossel: determining the chemical composition of nucleic acids
- Max Kramer: Aircraft engineer. Developed the first operational guided bomb in 1942/43. This first smart bomb was radio controlled and joy-stick operated.
- Hans Adolf Krebs: discovered two important chemical reactions in the body, namely the urea cycle and the citric acid cycle.
- Wilhelm Krische: Galalith
- Julius H. Kroehl: Inventor and engineer, who built the first functioning submarine in the world.
- Herbert Kroemer: Physicist, shared the Nobel Prize in Physics 2000 for developing semiconductor heterostructures used in high-speed- and opto-electronics.
- Werner Krüger: Developed the Krueger flap, a lift enhancement device in modern aircraft wings in 1943.
- Alfred Krupp: Pioneer in metal casting and metal working process and procedures.
- Adam Johann von Krusenstern: Navigator and explorer, led the first Russian expedition to circumnavigate the earth.
- Dietrich Küchemann: Aeronautical pioneer, developed wings for supersonic speed, such as delta wings as used in the Concorde.
- Heinz Kunert: Defogger for automobiles.
- Felix Klein: Invented the Erlangen Program, classifying geometries by their underlying symmetry groups, was a highly influential synthesis of much of the mathematics of the day. Also invented the Klein bottle, Beltrami-Klein model and wrote Klein's encyclopedia.
- Albert Ladenburg: isolated hyoscine
- Eugen Langen: Entrepreneur, engineer and inventor, involved in the development of the petrol engine and the Wuppertal monorail.
- Paul Langerhans: Islets of Langerhans, Langerhans cells
- Max von Laue: Discoveries regarding the diffraction of X-rays in crystals.
- Ernst Lecher: He is remembered for developing an apparatus—"Lecher lines"—to measure the wavelength and frequency of electromagnetic waves.
- Gottfried Wilhelm Leibniz: Philosopher known for discovering the mathematical field of calculus and coherently laying down its basic operations in 1684. The modern binary number system, the basis for binary code, was invented by Gottfried Leibniz in 1679 and appears in his article Explication de l'Arithmétique Binaire.
- Emil Lerp: inventor of transportable gasoline chainsaw, 1927
- Georg Christoph Lichtenberg: German scientist credited with the development of the electrophorus. he is remembered for his posthumously published notebooks, which he himself called Sudelbücher, a description modeled on the English bookkeeping term "scrapbooks", and for his discovery of the strange tree-like electrical discharge patterns now called Lichtenberg figures.
- Justus von Liebig: German chemist who made contributions to agricultural and biological chemistry.
- Otto Lilienthal: Father of Aviation and first successful aviator. Main discovery was the properties and shape of the wing.
- Carl von Linde: Engineer who, among other things, developed refrigeration and gas separation technologies.
- Alexander Lippisch: Pioneer of aerodynamics, his most famous design is the Messerschmitt Me 163.
- Ernst Litfaß: free-standing cylindrical advertising column.
• Friedrich Loeffler: discovered the organism causing diphtheria (Corynebacterium diphtheriae) and the cause of foot-and-mouth disease (Aphthovirus). His description of the diphtheria bacillus, published in 1884.

• Johann Benedict Listing: German mathematician who was a doctoral student under Carl Friedrich Gauss, he first introduced the term "topology", in a famous article published in 1847, although he had used the term in correspondence some years earlier. He (independently) discovered the properties of the half-twisted strip at the same time (1858) as August Ferdinand Möbius, and went further in exploring the properties of strips with higher-order twists (paradromic rings). He discovered topological invariants which came to be called Listing numbers. He also framed the Listing's law.

• Maria Goeppert-Mayer: Maria Goeppert Mayer was a German-born American theoretical physicist, and Nobel laureate in Physics for proposing the nuclear shell model of the atomic nucleus. She was the second woman to win a Nobel Prize in physics, after Marie Curie.


• Karl Marx: Political economist and philosopher, who defined the political/economical background of capitalism and discovered the mechanics of Marxism.

• J. Heinrich Matthaeci: Together with Marshall Nirenberg, they show that a sequence of nucleotide can encode particular amino acid, laying the foundations for deciphering the genetic code.

• Wilhelm Maybach: Together with Gottlieb Daimler the first gasoline-powered motorcycle, power-engine boat and later, 1902, the Mercedes car model.

• Ottomar von Mayenburg: Inventor of "Chlorodont", the first commercial brand of toothpaste.

• Georg Meissner: Discovered Meissner's plexus.

• Lise Meitner: Nuclear physicist, who, together with Otto Frisch, provided a theoretical account of nuclear fission.

• Julius Lothar Meyer: With Mendeleev he developed the periodic classification of the elements in order of their atomic weight.

• Christian Erich Hermann von Meyer: He discovered the Triassic predator Teratosaurus, the earliest bird Archaeopteryx lithographica (1861), the pterosaur Rhamphorhynchus, and the prosauropod dinosaur Plateosaurus.

• Gregor Mendel: Discoveries in genetics. Mendel demonstrated that the inheritance of certain traits in pea plants follows particular patterns, now referred to as the laws of Mendelian inheritance. First published in 1865.

• Ottmar Mergenthaler: Inventor who has been called a second Gutenberg because of his invention of the Linotype machine.

Johannes Peter Müller: Discoveries in physiology.

August Ferdinand Möbius: German mathematician and theoretical astronomer. He is best known for his discovery of the Möbius strip, independently discovered by Johann Benedict Listing around the same time. The Möbius configuration, formed by two mutually inscribed tetrahedra, is also named after him. Möbius was the first to introduce homogeneous coordinates into projective geometry. Many mathematical concepts are named after him, including the Möbius plane, the Möbius transformations, important in projective geometry, and the Möbius transform of number theory. His interest in number theory led to the important Möbius function \( \mu(n) \) and the Möbius inversion formula. In Euclidean geometry, he systematically developed the use of signed angles and line segments as a way of simplifying and unifying results.

Karl Mollweide: German mathematician and astronomer. In trigonometry, he discovered the formula known as Mollweide's formula. He invented a map projection called the Mollweide projection.

Walther Meissner: He established the world's third largest helium-liquifier, and discovered in 1933 the Meissner effect, damping of the magnetic field in superconductors.

Thomas Nast: The German American "Father of the American Cartoon".

Walther Nernst: Inventor of the Nernst lamp and Nobel laureate 1920 in Chemistry.

Karl Nessler: Inventor of the permanent wave.

Paul Gottlieb Nipkow: Technician and inventor, the "spiritual father" of the core element of first generation television technology.

Emmy Noether: Mathematician. Groundbreaking contributions to abstract algebra and theoretical physics (Noether's theorem). Considered by many as the most influential woman in the history of mathematics.

Hermann Oberth: Pioneer of rocket science and discoverer of the Oberth effect.

Georg Ohm: physicist and mathematician, discoverer of the Ohm's law and Ohm's acoustic law

August Oetker: Pharmacist. He was the first to sell baking powder in small packets to households instead of bakeries (as others before him) and thus made it the popular product we know today.

Hans Joachim Pabst von Ohain: The modern jet engine in 1933, patented in 1936. Frank Whittle had developed a similar concept independently in 1928/1929.

Wilhelm Ostwald: German chemist who received the Nobel Prize in Chemistry in 1909 for his work on catalysis, chemical equilibria and reaction velocities. Ostwald, Jacobus Henricus van 't Hoff, and Svante Arrhenius are usually credited with being the modern founders of the field of physical chemistry.

Nikolaus August Otto: Inventor of the first internal-combustion engine to efficiently burn fuel directly in a piston chamber.
• Wolfgang Paul: Physicist. Co-developed the non-magnetic quadrupole mass filter which laid the foundation for what we now call an ion trap. Shared the Nobel Prize in 1989.


• Rudolf Peierls: nuclear physicist.

• Julius Richard Petri: Bacteriologist who is generally credited with inventing the Petri dish while working as assistant to Robert Koch.

• Emil Pfeiffer: Discovery of Infectious mononucleosis

• Fritz Pflüger: Inventor of magnetic tape for recording sound. He built the world's first practical tape recorder, called Magnetophon K1.

• Joseph Pilates: Inventor of the physical fitness system named after him: Pilates

• Max Planck: Physicist, Scientist. He is considered to be the founder of the quantum theory, and one of the most important physicists of the twentieth century.

• Robert Wichard Pohl: In 1938, together with Rudolf Hilsch, built first functioning solid-state amplifier using salt as the semiconductor.

• Ludwig Prandtl: First to explain the boundary layer and its importance for drag and streamlining in aircraft in 1904. He established and headed the Aerodynamische Versuchsanstalt in Göttingen, now Max Planck Institute for Dynamics and Self-Organization. During his tenure the first wind tunnel in Germany was built here, thereby establishing a specific design for wind tunnels (Göttingen type).

• Johann Friedrich Pfaff: One of Germany's most eminent mathematicians during the 19th century. He studied mathematical series and integral calculus, and is noted for his work on partial differential equations of the first order (Pfaffian systems as they are now called) which became part of the theory of differential forms.

• Julius Plücker: Framed the Plücker formula. He made fundamental contributions to the field of analytical geometry and was a pioneer in the investigations of cathode rays that led eventually to the discovery of the electron. He also vastly extended the study of Lamé curves.

• Harald Popp: Inventor and audio engineer; father of audio compression format MPEG Audio Layer 3, more commonly known as MP3.

• Adolf Rambold: Inventor of modern tea bag.

• Johann Philipp Reis: Inventor of the first phone transmitter in 1861, he also invented the term Telephone.

• Josef Rodenstock: Founder of Rodenstock, manufacturer of optical systems, ophthalmic lenses and spectacles frames.

• Paul Julius Freiherr von Reuter: Communications pioneer.
• Fritz Reiche: Was a student of Max Planck and a colleague of Albert Einstein, who was active in, and made important contributions to the early development of quantum mechanics including co-authoring the Thomas-Reiche-Kuhn sum rule.
• Hans Reichel: Musical instrument inventor. Inventor of the daxophone and various overtone guitars.
• Bernhard Riemann: Mathematician, who made lasting contributions to analysis, number theory, and differential geometry.
• Johann Wilhelm Ritter: Physicist and discoverer of Ultraviolet.
• Wilhelm Conrad Röntgen: Physicist and discoverer of x-rays/Röntgen rays (8 November 1895), this earned him the first Nobel Prize in Physics in 1901.
• Arthur Rudolph: Rocket engineer who, together with Wernher von Braun, played a key role in the development of the V-2 rocket.
• Heinrich Daniel Ruhmkorff: German instrument maker who commercialized the induction coil (often referred to as the Ruhmkorff coil).
• Ernst Ruska: Physicist, developed the first electron microscope in 1933. Nobel laureate 1986.
• Karl Wilhelm Rosenmund: He discovered the Rosenmund reduction, which is the reduction of acyl chlorides to aldehydes over palladium-on-carbon catalyst. The Rosenmund-von Braun reaction, the conversion of an aryl bromide to an arylnitride is also named after him.
• Carl Wilhelm Scheele: Oxygen (although Joseph Priestley published his findings first), identification of molybdenum, tungsten, barium, hydrogen and chlorine
• Arthur Scherbius: Developed the mechanical cipher machine Enigma. Patent granted in 1918.
• Wilhelm Schickard: mechanical calculator in 1623.
• Paul Schlack: Invented Nylon 6.
• Friedrich Albert Moritz Schlick: Was a German philosopher, physicist and the founding father of logical positivism and the Vienna Circle.
• Heinrich Schliemann: One of the fathers of modern archaeology, among other things he discovered Homeric Troy.
• Hugo Schmeisser: Developed the first modern assault rifle StG 44 in 1942.
• Bernhard Schmidt: Developed a photographic telescope with minimal optical errors: the Schmidt camera.
• Paul Schmidt: Developed since 1928 his idea of a new drive, the "pulsating incineration", also used in the V-1 flying bomb (engine was called "Argus-Schmidtrohr"); pulsejet was a development by Schmidt.
• Christian Friedrich Schönbein: Professor Schönbein is credited with four scientific advances: Ozone, Gun cotton, Collodion and Fuel cell
- Johann Lukas Schönlein: Professor of medicine, he discovered among other things the parasitic cause of ringworm or favus (Achorion Schönleinii).
- Otto Schoetensack: Named the Homo heidelbergensis.
- Otto Schott: Inventor of borosilicate glass. Donated his shares in the company Carl Zeiss to form Carl-Zeiss-Stiftung, still in existence today.
- Walter H. Schottky: Played a major early role in developing the theory of electron and ion emission phenomena, invented the screen-grid vacuum tube and the pentode.
- Johannes Heinrich Schultz: developed the desensitization-relaxation technique called Autogenic training.
- Marx Schwab: Silversmith, invented coining with the screw press around 1550.
- Theodor Schwann: Discovery of properties of cells in animals.
- Karl Schwarzschild: astronomer, Schwarzschild metric, Deriving the Schwarzschild solution, Schwarzschild radius
- Alois Senefelder: He invented the printing technique of lithography in 1796.
- Friedrich Sertürner: First to isolate morphine from the opium poppy in 1803/1804, discovering morphine.
- Philipp Franz von Siebold: Physician and naturalist, detailed description and collection of the Japanese flora and fauna. Introduced Western medicine to Japan and opened a medical school.
- Ernst Werner von Siemens: Dynamo, pointer telegraph that used a needle to point to the right letter, first electric elevator, trolleybus.
- Max Skladanowsky: Bioscop, German inventor and early filmmaker.
- Friedrich Soennecken: Invented Hole punch and ring binder.
- Arnold Sommerfeld: Theoretical physicist who pioneered developments in atomic and quantum physics.
- Johannes Stark: Discovery of the Doppler effect in canal rays and the splitting of spectral lines in electric fields" (the latter is known as the Stark effect).
- Jack Steinberger: German-American-Swiss physicist, co-discovered the muon neutrino, shared 1988 Nobel Prize in Physics.
- Georg Wilhelm Steller: Chief naturalist on Vitus Bering's expedition during which Alaska was discovered (1741) and pioneer of Alaskan Natural History. Steller's sea cow (now extinct) was named after him.
- Heinrich Stölzel: Developed the valve for brass instruments which is used today in 1818. Friedrich Blühmel had made a similar development independently at the same time.
- Ernst Stromer: Discovery and Describing of Aegyptosaurus, Bahariasaurus, Carcharodontosaurus, and the largest known theropod, Spinosaurus aegyptiacus. Stromer also described the giant crocodilian Stomatosuchus.
- Friedrich Wilhelm "Fritz" Strassmann: German chemist who, with Otto Hahn in early 1939, identified barium in the residue after bombarding uranium with neutrons, results which, when confirmed, demonstrated the previously unknown phenomenon of nuclear fission.
- Hubertus Strughold: German-born physiologist and prominent medical researcher. For his role in pioneering the study of the physical and psychological effects of manned spaceflight he became known as "The Father of Space Medicine".
- Thomas C. Südhof: biochemist, discovered how molecule signals instruct vesicles to release their cargo in cell. Shared the Nobel prize in Physiology or Medicine 2013.
- Ehrenfried Walther von Tschirnhaus: He is considered to have been the inventor of European porcelain.
- Oscar Troplowitz: He invented adhesive tape, Leukoplast.
- Dietrich "Diedrich" Uhlhorn: Engineer, mechanic and inventor, who invented the first mechanical tachometer (1817), between 1817 and 1830 inventor of the Presse Monétaire (level coin press known as Uhlhorn Press) which bears his name.

List of Russian physicists

- Alexei Abrikosov, discovered how magnetic flux can penetrate a superconductor (the Abrikosov vortex), Nobel Prize winner
- Franz Aepinus, related electricity and magnetism, proved the electric nature of pyroelectricity, explained electric polarization and electrostatic induction, invented achromatic microscope
- Zhores Alferov, inventor of modern heterotransistor, Nobel Prize winner
- Artem Alikhanian, a prominent researcher of cosmic rays, inventor of wide-gap track spark chamber
- Abraham Alikhanov, nuclear physicist, a prominent researcher of cosmic rays, built the first nuclear reactors in the USSR
- Semen Altshuler, researched EPR and NMR, predicted acoustic paramagnetic resonance
- Lev Artsimovich, builder of the first tokamak, researcher of high temperature plasma
- Gurgen Askaryan, predicted self focusing of light, discovered Askaryan effect in the particle physics
- Nikolay Basov, physicist, co-inventor of laser and maser, Nobel Prize winner
• **Nikolay Bogolyubov**, mathematician and theoretical physicist, co-developed the BBGKY hierarchy, formulated a microscopic theory of superconductivity, suggested a triplet quark model, introduced a new quantum degree of freedom (color charge)

• **Matvei Petrovich Bronstein**, theoretical physicist, a pioneer of quantum gravity, author of works in astrophysics, semiconductors, quantum electrodynamics and cosmology.

• **Gersh Budker**, inventor of electron cooling, co-inventor of collider

• **Sergey Chaplygin**, a founder of aero- and hydrodynamics, formulated the Chaplygin's equations and Chaplygin gas concept

• **Pavel Cherenkov**, discoverer of Cherenkov radiation, Nobel Prize winner

• **Yuri Denisyuk**, inventor of 3D holography

• **Ludvig Faddeev**, discoverer of Faddeev–Popov ghosts and Faddeev equations in quantum physics

• **Georgy Flyorov**, nuclear physicist, one of the initiators of the Soviet atomic bomb project, co-discoverer of seaborgium and bohrium, founder of the Joint Institute for Nuclear Research

• **Vladimir Fock**, developed the Fock space, Fock state and the Hartree–Fock method in quantum mechanics

• **Ilya Frank**, explained the phenomenon of Cherenkov radiation, Nobel Prize winner

• **Vsevolod Frederiks (Fréedericksz)**, discovered the Fréedericksz transition, the Fréedericksz critical field in liquid crystals

• **Yakov Frenkel**, coined the term electron hole, discovered the Frenkel defect of a crystal lattice, described the Poole–Frenkel effect in solid-state physics

• **Andre Geim**, inventor of graphene, developer of gecko tape, Nobel Prize winner and at the same time Ig Nobel Prize winner for diamagnetic levitation of a living frog

• **Vitaly Ginzburg**, co-author of the Ginzburg–Landau theory of superconductivity, a developer of hydrogen bomb, Nobel Prize winner

• **Vladimir Gribov**, introduced pomeron, DGLAP equations and Gribov ambiguity

• **Aleksandr Gurevich**, author of the runaway breakdown theory of lightning

• **Abram Ioffe**, founder of the Soviet physics school, tutor of many prominent scientists

• **Dmitri Ivanenko**, pioneered the modelling of nuclear shell and nuclear forces, predicted synchrotron radiation, suggested the quark stars existence

• **Boris Jacobi**, formulated the Maximum power theorem in electrical engineering, invented electroplating, electrotyping, galvanoplastic sculpture and electric boat

• **Pyotr Kapitsa**, originated the techniques for creating ultrastrong magnetic fields, co-discovered a way to measure the magnetic field of an atomic nucleus discovered superfluidity, Nobel Prize winner

• **Yuly Khariton**, chief designer of the Soviet atomic bomb, co-developer of the Tsar Bomb
- Orest Khvolson, the first to study the Chwolson ring effect of gravitational lensing
- Sergey Krasnikov, developer of the Krasnikov tube, a speculative mechanism for space travel
- Igor Kurchatov, builder of the first nuclear power plant, developer of the first nuclear reactors for surface ships
- Lev Landau, theoretical physicist, developed the Ginzburg–Landau theory of superconductivity, explained the Landau damping in plasma physics, pointed out the Landau pole in quantum electrodynamics, co-author of the famous *Course of Theoretical Physics*, Nobel Prize winner
- Grigory Landsberg, co-discoverer of Raman scattering of light
- Mikhail Lavrentyev, physicist and mathematician, founded the Siberian Division of the Soviet Academy of Sciences and Akademgorodok in Novosibirsk
- Pyotr Lebedev, the first to measure the radiation pressure on a solid body, thus proving the Maxwell's theory of electromagnetism
- Heinrich Lenz, discovered the Lenz's law of electromagnetism
- Aleksandr Il'ich Leipunskii, pioneered the development of fast breeder reactors in the USSR.
- Evgeny Lifshitz, an author of the BKL singularity model of the Universe evolution, co-author of the famous *Course of Theoretical Physics*
- Mikhail Lomonosov, polymath scientist, artist and inventor, proposed the law of conservation of matter, disproved the phlogiston theory
- Oleg Losev, inventor of light-emitting diode and crystadine
- Alexander Makarov, inventor of orbitrap
- Boris Mamyrin, inventor of reflectron
- Leonid Mandelshtam, co-discoverer of the Raman effect
- Stanislav Mikheyev, co-discoverer of the Mikheyev–Smirnov–Wolfenstein effect of neutrino oscillations
- Konstantin Novoselov, inventor of graphene, developer of gecko tape, Nobel Prize winner
- Yuri Oganessian, nuclear physicist in the Joint Institute for Nuclear Research, co-discoverer of the heaviest elements in the periodic table; element Oganesson
- Vasily Petrov, discoverer of electric arc, proposed arc lamp and arc welding
- Boris Podolsky, an author of EPR Paradox in quantum physics
- Alexander Polyakov, developed the concepts of Polyakov action, 't Hooft–Polyakov monopole and BPST instanton
- Isaak Pomeranchuk, predicted synchrotron radiation
• Bruno Pontecorvo, a founder of neutrino high energy physics, his work led to the discovery of PMNS matrix

• Alexander Popov, inventor of lightning detector, one of the inventors of radio, recorded the first experimental radiolocation at sea

• Victor Popov, co-discoverer of Faddeev–Popov ghosts in quantum field theory

• Alexander Prokhorov, co-inventor of laser and maser, Nobel Prize winner

• Georg Wilhelm Richmann, inventor of electrometer, pioneer researcher of atmospheric electricity, killed by a ball lightning in experiment

• Andrei Sakharov, co-developer of tokamak and the Tsar Bomb, inventor of explosively pumped flux compression generator, Nobel Peace Prize winner

• Nikolay Semyonov, physical chemist, co-discovered a way to measure the magnetic field of an atomic nucleus, Nobel Prize in Chemistry winner

• Lev Shubnikov, discoverer of Shubnikov–de Haas effect, one of the first researchers of solid hydrogen and liquid helium

• Dmitri Skobeltsyn, the first to use cloud chamber for studying cosmic rays, the first to observe positrons

• Alexei Smirnov, co-discoverer of Mikheyev–Smirnov–Wolfenstein effect of neutrino oscillations

• Arseny Sokolov, co-discoverer of Sokolov–Ternov effect, a developer of synchrotron radiation theory

• Aleksandr Stoletov, inventor of photoelectric cell, built the Stoletov curve and pioneered the research of ferromagnetism

• Igor Tamm, explained the phenomenon of Cherenkov radiation, co-developer of tokamak, Nobel Prize winner

• Igor Ternov, co-discoverer of Sokolov–Ternov effect of synchrotron radiation

• Nikolay Umov, discovered the Umov-Poynting vector and Umov effect, the first to propose the formula

• Petr Ufimtsev, developed the theory that led to modern stealth technology

• Sergey Vavilov, co-discoverer of Cherenkov radiation, formulated the Kasha–Vavilov rule of quantum yields

• Vladimir Veksler, inventor of synchrophasotron, co-inventor of synchrotron

• Evgeny Velikhov, leader of the international program ITER (thermonuclear experimental tokamak)

• Anatoly Vlasov, developed the Vlasov equation in plasma physics

• Alexey Yekimov, discoverer of quantum dots

• Yevgeny Zavoisky, inventor of EPR spectroscopy, co-developer of NMR spectroscopy
• **Yakov Zel’dovich**, physicist and cosmologist, predicted the beta decay of a pi meson and the muon catalysis, co-predicted the Sunyaev–Zel’dovich effect of CMB distortion

• **Nikolai Zhukovsky**, a founder of aero- and hydrodynamics, the first to study airflow, author of Joukowsky transform and Kutta–Joukowski theorem, founder of TsAGI and pioneer of aviation

**List of Russian astronomers and astrophysicists**

- **Tateos Agekian**, one of the pioneers of Russian and world Stellar dynamics, discoverer of two evolutionary sequences of stellar systems: nearly spherical and strongly flattened
- **Vladimir Albitsky**, discovered a significant number of asteroids
- **Viktor Ambartsumian**, one of the founders of theoretical astrophysics, discoverer of stellar associations, founder of Byurakan Observatory in Armenia
- **Andrejs Auzāns**, director of the Tashkent observatory, 1911-1916
- **Nikolai P. Barabashov**, co-author of the ground breaking publication of the first pictures of the far side of the Moon in 1961, called *Atlas of the Other Side of the Moon*; a crater and a planet were named after him
- **Vladimir Belinski**, an author of the BKL singularity model of the Universe evolution
- **Igor Belkovich**, made contributions to astronomy; the crater Bel’kovich on the Moon is named after him
- **Aristarkh Belopolsky**, invented a spectrograph based on the Doppler effect, among the first photographers of stellar spectra
- **Sergey Belyavsky**, discovered the bright naked-eye comet C/1911 S3 (Beljawsky); discovered and co-discovered a number of asteroids
- **Gennady S. Bisnovatyi-Kogan**, first determined the maximum mass of a hot neutron star
- **Sergey Blazhko**, discovered a secondary variation of the amplitude and period of some RR Lyrae stars and related pulsating variables, now known as the Blazhko effect
- **Semion Braude**, co-developed large-scale radio interferometers for precise examination of extraterrestrial radio sources
- **Fyodor Bredikhin**, developed the theory of comet tails, meteors and meteor showers, a director of the Pulkovo Observatory
- **Matvei Petrovich Bronstein**, theoretical physicist; pioneer of quantum gravity; author of works in astrophysics, semiconductors, quantum electrodynamics and cosmology
- **Jacob Bruce**, statesman, naturalist and astronomer, founder of the first observatory in Russia (in the Sukharev Tower)
- **Lyudmila Chernykh**, astronomer, discovered 268 asteroids
• **Nikolai Chernykh**, astronomer, discovered 537 asteroids and two comets
• **Aleksandr Chudakov**, co-discoverer of the Earth's radiation belt
• **Denis Denisenko**, astronomer, author of more than 25 scientific articles and a presenter at five international conferences
• **A. G. Doroshkevich**, along with Igor Novikov, discovered cosmic microwave background radiation as a detectable phenomenon
• **Alexander Dubyago**, expert in theoretical astrophysics; the lunar crater Dubyago is named after him and his father, Dmitry Ivanovich Dubyago
• **Dmitry Dubyago**, expert in theoretical astrophysics, astrometry, and gravimetry; a crater on the Moon is named after him and his son
• **Vasily Engelhardt**, researched comets, asteroids, nebulae, and star clusters, in an observatory he built himself
• **Vasily Fesenkov**, founded the Alma-Ata (now Tien Shan) astrophysical observatory, and was the first to make a study of Zodiacal light using photometry, and suggested a theory of its dynamics
• **Kirill Florensky**, head of Comparative Planetology at the Vernadsky Institute of the U.S.S.R. Academy of Sciences; the crater Florensky on the Moon is named after him
• **Alexander Friedmann**, mathematician and cosmologist, discovered the expanding-universe solution to the general relativity field equations.; authored the FLRW metric of Universe
• **Alexei Fridman**, predicted existence of smaller satellites around Uranus
• **George Gamow**, theoretical physicist and cosmologist, discovered alpha decay via quantum tunneling and Gamow factor in stellar nucleosynthesis, introduced the Big Bang nucleosynthesis theory, predicted cosmic microwave background
• **Vitaly Ginzburg**, co-developed the theory of superconductivity, the theory of electromagnetic wave propagation in plasmas, and a theory of the origin of cosmic radiation
• **Sergey Glazenap**, astronomer; a crater on the Moon and the minor planet 857 Glasenappia are named after him
• **Alexander A. Gurshtein**, developed a concept of history of constellations and the zodiac
• **Matvey Gusev**, the first to prove the non-sphericity of the Moon, pioneer of photography in astronomy
• **Naum Idelson**, astronomer
• **Benjamin Jekhowsky**, discovered a number of asteroids; made more than 190 scientific publications; the asteroid 1606 Jekhovsky is named after him
• **Lyudmila Karachkina**, discovered a number of asteroids, including the Amor asteroid 5324 Lyapunov, 10031 Vladarnolda and the Trojan asteroid 3063 Makhaon
• Nikolai Kardashev, astrophysicist, inventor of Kardashev scale for ranking the space civilizations
• Isaak Khalatnikov, an author of the BKL singularity model of the Universe evolution
• Viktor Knorre, astronomer, discovered four asteroids
• Marian Kowalski, first to measure the rotation of the Milky Way
• Nikolai Aleksandrovich Kozyrev, astronomer, observed the transient lunar phenomenon
• Georgij A. Krasinsky, astronomer, researched planetary motions and ephemeris
• Feodosy Krasovsky, astronomer and geodesist; measured the Krasovsky ellipsoid, a coordinate system used in the USSR and the post-Soviet states
• Yevgeny Krinov, astronomer, renowned meteorite researcher; the mineral Krinovite, discovered in 1966, was named after him
• Anders Johan Lexell, astronomer and mathematician; researcher of celestial mechanics and comet astronomy; proved that Uranus is a planet rather than a comet
• Andrei Linde, created the Universe chaotic inflation theory
• Evgeny Lifshitz, an author of the BKL singularity model of the Universe evolution
• Mikhail Lomonosov polymath, inventor of the off-axis reflecting telescope, discoverer of the atmosphere of Venus
• Mikhail Lyapunov, astronomer
• Kronid Lyubarsky, worked on the Soviet program of interplanetary exploration of Mars
• Benjamin Markarian, discovered Markarian's Chain
• Dmitri Dmitrievich Maksutov, inventor of the Maksutov telescope
• Aleksandr Aleksandrovich Mikhailov, credited with leading the post-war revival of the Pulkovo Observatory
• Nikolay Moiseyev, expert in celestial mechanics, worked on mathematical methods of celestial calculations and theory of comet formation
• Grigory Neujmin, discovered 74 asteroids, and most notably 951 Gaspra and 762 Pulcova
• Igor Dmitriyevich Novikov, formulated the Novikov self-consistency principle, an important contribution to the theory of time travel
• Boris Numerov, created various astronomic and mineralogical instruments, as well as various algorithms and methods that bear his name
• Pavel Petrovich Parenago, known for contributions to the field of galactic astronomy
• Yevgeny Perepyolkin, observed the proper motion of stars with respect to extragalactic nebula
- Solomon Pikelner, made a significant contribution to the theory of the interstellar medium, solar plasma physics, stellar atmospheres, and magnetohydrodynamics
- Elena V. Pitjeva, expert in the field of Solar System dynamics and celestial mechanics
- Viktor Safronov, astronomer and cosmologist, author of the planetesimal hypothesis of planet formation
- Kaspar Gottfried Schweizer, discovered five comets, and found one NGC object
- Andrei Severny, known for his work on solar flares and astronomical observations from artificial satellites
- Nikolai Shakura, developed theory of accretion and astrophysics of x-ray binaries, co-developed the standard theory of disk accretion
- Grigory Shayn, astronomer and astrophysicist, the first director of the Crimean Astrophysical Observatory, co-developed a method for measurement of stellar rotation
- Vladislav Shevchenko, astronomer, specialized in lunar exploration
- Iosif Shklovsky, astronomer and astrophysicist, author of several discoveries in the fields of radio astronomy and cosmic rays, extraterrestrial life researcher
- Tamara Mikhaylovna Smirnova, co-discovered the periodic comet 74P/Smirnova-Chernykh, along with Nikolai Stepanovich Chernykh; discovered various asteroids; the asteroid 5540 Smirnova was named in her honor
- Friedrich Wilhelm Struve, astronomer and geodesist, founder and the first director of the Pulkovo Observatory, prominent researcher and discoverer of new double stars, initiated the construction of 2,820 km long Struve Geodetic Arc, progenitor of the Struve family of astronomers
- Otto Lyudvigovich Struve, astronomer and astrophysicist, co-developed a method for measurement of stellar rotation, directed several observatories in the U.S.
- Otto Wilhelm von Struve, astronomer, director of the Pulkovo Observatory, discovered over 500 double stars
- Rashid Sunyaev, astrophysicist, co-predicted the Sunyaev–Zel'dovich effect of CMB distortion
- Gavriil Tikhov, invented the feathering spectrograph; one of the first to use color filters to increase the contrast of surface details on planets
- George Volkoff, predicted the existence of neutron stars
- Boris Vorontsov-Velyaminov, discovered the absorption of light by interstellar dust, author of the Morphological Catalogue of Galaxies
- Alexander Vyssotsky, created first list of nearby stars identified not by their motions in the sky, but by their intrinsic, spectroscopic, characteristics
- Avenir Aleksandrovich Yakovkin, astronomer
- Ivan Yarkovsky, discovered the YORP and Yarkovsky effects of meteoroids or asteroids
• **Aleksandr Zaitsev**, coined the term Messaging to Extra-Terrestrial Intelligence, conducted the first intercontinental radar astronomy experiment, transmitted the Cosmic Calls and Teen Age Message

• **Yakov Zel'dovich**, physicist, astrophysicist and cosmologist, the first to suggest that accretion discs around massive black holes are responsible for the quasar radiation, co-predicted the Sunyaev–Zel'dovich effect of CMB distortion

• **Abram Leonidovich Zelmanov**, astronomer

• **Sergei Alexandrovich Zhevakin**, identified ionized helium as the valve for the heat engine that drives the pulsation of Cepheid variable stars

• **Lyudmila Zhuravlyova**, discovered a number of asteroids; ranked 43rd by Harvard University's list of those who discovered minor planets; credited with having discovered 200 such bodies

• **Felix Ziegel**, author of more than 40 popular books on astronomy and space exploration, generally regarded as a founder of Russian ufology

### List of social psychology theories

- **Attribution theory** – is concerned with the ways in which people explain (or attribute) the behaviour of others. The theory divides the way people attribute causes to events into two types. External or "situational" attributions assign causality to an outside factor, such as the weather. Internal or "dispositional" attributions assign causality to factors within the person, such as ability or personality.

- **Cognitive dissonance** – was originally based on the concept of cognitive consistency, but is now more related to self-concept theory. When people do something that violates their view of themselves, this causes an uncomfortable state of dissonance that motivates a change in either attitudes or behaviour (Festinger, 1957).

- **Drive theory** – posits that the presence of an audience causes arousal which creates dominant or typical responses in the context of the situation.

- **Elaboration likelihood model** – maintains that information processing, often in the case of a persuasion attempt can be divided into two separate processes based on the "likelihood of cognitive elaborations," that is, whether people think critically about the content of a message, or respond to superficial aspects of the message and other immediate cues.

- **Motivation crowding theory** – suggests that extrinsic motivators such as monetary incentives or punishments can undermine (or, under different conditions, strengthen) intrinsic motivation.

- **Observational learning (social learning)** – suggests that behaviour can be acquired by observation and imitation of others, unlike traditional learning theories which require reinforcement or punishment for learning to occur.
- **Positioning theory** – focuses on the moral orders that occur in conversations as a result of the interplay between the speech-acts uttered, the positions taken and the developing story-line.

- **Schemata theory** – focuses on "schemas" which are cognitive structures that organize knowledge and guide information processing. They take the form of generalized beliefs that can operate automatically and lead to biases in perception and memory.

- **Self-perception theory** – emphasizes that we observe ourselves in the same manner that we observe others, and draw conclusions about our likes and dislikes. Extrinsic self perceptions can lead to the over-justification effect.

- **Self-verification theory** – focuses on people’s desire to be known and understood by others. The key assumption is that once people develop firmly held beliefs about themselves, they come to prefer that others see them as they see themselves.

- **Social comparison theory** – suggests that humans gain information about themselves, and make inferences that are relevant to self-esteem, by comparison to relevant others.

- **Social exchange theory** – is an economic social theory that assumes human relationships are based on rational choice and cost-benefit analyses. If one partner's costs begin to outweigh his or her benefits, that person may leave the relationship, especially if there are good alternatives available.

- **Social identity theory** – was developed by Henri Tajfel and examines how categorizing people (including oneself) into ingroups or outgroups affects perceptions, attitudes, and behavior.

- **Social penetration theory** – proposes that, as relationships develop, interpersonal communication moves from relatively shallow, non-intimate levels to deeper, more intimate ones. The theory was formulated by psychologists Irwin Altman and Dalmas Taylor in 1973 to provide an understanding of the closeness between two individuals.

- **Socioemotional selectivity theory** – posits that as people age and their perceived time left in life decreases, they shift from focusing on information seeking goals to focusing on emotional goals.

- **System justification theory** – proposes that people have a motivation to defend and bolster the status quo, in order to continue believing that their social, political, and economic systems are legitimate and just.

- **Terror management theory** – suggests that human mortality causes existential dread and terror, and that much of human behavior exists as a buffer against this dread (e.g., self-esteem and worldviews).

- **Triangular theory of love** – by Sternberg, characterizes love in an interpersonal relationship on three different scales: intimacy, passion, and commitment. Different stages and types of love can be categorized by different combinations of these three elements.
List of Modern Greek mathematicians

- Roger Apéry (1916–1994) - Professor of mathematics and mechanics at the University of Caen Proved the irrationality of zeta(3).
- Tom M. Apostol (1923-2016) - Professor of mathematics in California Institute of Technology, he has authored a number of books about mathematics.
- Dimitri Bertsekas (born 1942) - Member of the National Academy of Engineering professor with the Department of Electrical Engineering and Computer Science. Author of fifteen books and research monographs, and coauthor of an introductory probability textbook
- Giovanni Carandino (1784–1834)
- Constantin Carathéodory (1873–1950) - Mathematician who pioneered the Axiomatic Formulation of Thermodynamics.
- Demetrios Christodoulou (born 1951) - Mathematician-physicist who has contributed in the field of general relativity.
- Constantine Dafermos (born 1941) - Usually notable for hyperbolic conservation laws and control theory.
- Mihalis Dafermos (born 1976) - Reader in Mathematical Physics, University of Cambridge.
- Apostolos Doxiadis (born 1953) - Australian born Mathematician.
- Athanassios S. Fokas (born 1952) - Contributor in the field of integrable nonlinear partial differential equations.
- Michael Katehakis (born 1952) - Professor at Rutgers University.
- Nicholas Metropolis (1915–1999) - American born Greek physicist.
- Yiannis N. Moschovakis (1938) - Writer, also worked as theorist in University of California, Los Angeles.
- Christos Papakyriakopoulos (1914–1976) - Often called Papa, he specialized in geometric topology.
- Athanasios Papoulis (1921–2002) - Contributed a number of theories, such as Papoulis–Gerchberg algorithm, A eloquent proof, among others.
- Themistocles M. Rassias (born 1951) - Professor at the National Technical University of Athens.
- Raphaël Salem (1898-1963) - Was a Greek mathematician after whom are named the Salem numbers and whose widow founded the Salem Prize.
• Cyparissos Stephanos (1857–1917) - Notable contributor of desmic systems.
• Katia Sycara - Professor in the Carnegie Mellon School of Computer Science's Robotics Institute and the director of the Laboratory for Agents technology and Semantic web technologies.
• Nicholas Varopoulos (born 1940) - Notable for his analysis on Lie groups.
• Stathis Zachos (born 1947) - Published a number of writings on computer science.
• Mihail Zervos - Working in Department of Mathematics, London School of Economics.

List of inventions named after people

• Abney level – William de Wiveleslie Abney
• Aldis lamp – Arthur Cyril Webb Aldis
• Aldrin – Kurt Alder
• Alexanderson alternator – Ernst Alexanderson
• Algorithm – Muḥammad ibn Mūsā al-Khwārizmī
• Anderson shelter – John Anderson, 1st Viscount Waverley
• Anderton Shearer Loader – James Anderton
• Appertization – Nicolas Appert
• Archimedes' screw – Archimedes
• Argand lamp – Aimé Argand
• Armstrong breech-loading gun – William Armstrong, 1st Baron Armstrong
• Armstrong's acid – Henry Edward Armstrong
• Austenite – William Chandler Roberts-Austen
• Avtomat Kalashnikova (AK-47) – Mikhail Kalashnikov
• Bailey bridge – Donald Bailey
• Bakelite – Leo Baekeland
• Barlow lens, Barlow's wheel – Peter Barlow
• Bath Oliver – William Oliver
• Beaufort scale – Sir Francis Beaufort
• Beecham's Pills – Thomas Beecham
• Belisha beacon – Leslie Hore-Belisha, 1st Baron Hore-Belisha
• Benedict's reagent – Stanley Rossiter Benedict
• Benson raft – Simon Benson
• Bessemer converter – Henry Bessemer
•Billinghurst Requa Battery – William Billinghurst and Josephus Requa
• Birch gun – Noel Birch
• Bird's Custard – Alfred Bird
• Biro – László Bíró
• Blacker Bombard – Stewart Blacker
• Bloomers – Amelia Bloomer
• Botts' dots – Elbert Dysart Botts
• Bourdon gauge – Eugène Bourdon
• Bowden cable – Ernest Monnington Bowden
• Bowie knife – James Bowie
• Bowler hat – Thomas and William Bowler
• Bradshaw's Railway Guide – George Bradshaw
• Braille – Louis Braille
• Bramah Press – Joseph Bramah
• Brannock device – Charles F. Brannock
• Brennan torpedo – Louis Brennan
• Brougham – Henry Brougham, 1st Baron Brougham and Vaux
• M1918 Browning Automatic Rifle – John Browning
• Büchner funnel, Büchner flask – Ernst Büchner
• Bunsen burner – Robert Bunsen
• Burr Arch Truss – Theodore Burr
• Callanetics – Callan Pinckney
• Cardigan – James Brudenell, 7th Earl of Cardigan
• Carnot cycle, Carnot heat engine – Nicolas Léonard Sadi Carnot
• Cassegrain telescope – Laurent Cassegrain
• Catherine Wheel – Catherine of Alexandria
• Clerihew – Edmund Clerihew Bentley
• Coade stone – Eleanor Coade
• Codd-neck bottle – Hiram Codd
• Coddington magnifier – Henry Coddington
• Colt revolver – Samuel Colt
• Coffey still – Aeneas Coffey
• Congreve rocket – Sir William Congreve, 1st Baronet
• Crompton's mule – Samuel Crompton
• Crookes tube – William Crookes
• Cunningham – Briggs Cunningham
• Daguerreotype – Louis Daguerre
• Dalén light – Gustaf Dalén
• Daly detector – Norman Richard Daly
• Daniell cell – John Frederic Daniell
• Davenport desk – Captain John Davenport
• Davis Gun – Cleland Davis
• Davy lamp – Humphry Davy
• Derrick – Thomas Derrick
• Derringer – Henry Deringer
• Dewar flask – James Dewar
• Diesel engine, diesel fuel – Rudolf Diesel
• Dimroth condenser – Otto Dimroth
• Divers's solution – Edward Divers
• Dr. Martens – Klaus Märtens
• Dolby noise-reduction system – Ray Dolby
• Doppler radar – Christian Doppler
• Draisine – Karl Drais
• Edison effect (Thermionic emission) – Thomas Edison
• Edison screw – Thomas Edison
• Ehrlich's reagent – Paul Ehrlich
• Éolienne Bollée – Ernest Sylvain Bollée
- Ericsson engine – John Ericsson
- Erlenmeyer flask – Emil Erlenmeyer
- Euclidean geometry – Euclid
- Fairbairn-Sykes Fighting Knife – William Ewart Fairbairn and Eric Anthony Sykes
- Faraday cage – Michael Faraday
- Farrimond friction hitch – Barry Farrimond
- Flinders bar – Matthew Flinders
- Foley catheter – Frederic Foley
- Foucault pendulum – Léon Foucault
- Francis turbine – James B. Francis
- Franklin stove – Benjamin Franklin
- Fresnel lens – Augustin-Jean Fresnel
- Friedrichs condenser – Fritz Walter Paul Friedrichs
- Frost Airship Glider – William Frost
- Galil – Yisrael Galil
- Gallup Poll – George Gallup
- Galvanometer, galvanic cell – Luigi Galvani
- Garand – John Garand
- Gatling gun – Richard Jordan Gatling
- Gatso cameras – Maus Gatsonides
- Geiger counter – Hans Geiger
- Geiger-Müller tube – Hans Geiger and Walther Müller
- George Foreman Grill – George Foreman
- Gillette safety razor – King Camp Gillette
- Gladstone bag – William Ewart Gladstone
- Glauber's salt – Johann Rudolf Glauber
- Gore-Tex – Bill Gore
- Graham condenser – Thomas D. Graham
- Graham cracker – Rev Sylvester Graham
- Gramme dynamo – Zénobe Gramme
- Gregorian telescope – James Gregory
- Guillotine – Joseph-Ignace Guillotin
- Gurney Stove – Goldsworthy Gurney
- Halkett boat – Peter Halkett
- Hallidie ropeway – Andrew Smith Hallidie
- Halligan bar – Hugh Halligan
- Hammond organ – Laurens Hammond
- Heimlich Maneuver – Henry Heimlich
- Hele-Shaw clutch – Henry Selby Hele-Shaw
- Henry rifle – Benjamin Tyler Henry
- Higgins boat – Andrew Higgins
- Hobbs Meter – John Weston Hobbs
- Holter Monitor – Norman Holter
- Hoover – William Henry Hoover
- Horlicks – James and William Horlick
- Horsley–Clarke apparatus – Victor Horsley and Robert H. Clarke
- Horstmann suspension – Sidney Horstmann
- Howell torpedo – John Adams Howell
- Humphrey pump – H. A. Humphrey
- Hutchinson Patent Stopper – Charles G. Hutchinson
- Inglis Bridge – Charles Inglis
- Jacuzzi – Candido Jacuzzi
- Jacquard loom – Joseph Marie Jacquard
- Josephson junction – Brian David Josephson
- Kalashnikov – Mikhail Kalashnikov
- Kaplan turbine – Viktor Kaplan
- Kay's flying shuttle – John Kay
- Kégresse track – Adolphe Kégresse
- Kelvin bridge – William Thomson, 1st Baron Kelvin
• Ketchum Grenade – William F. Ketchum
• Kilner jar – John Kilner
• Kipp's apparatus – Petrus Jacobus Kipp
• Krarup cable – Carl Emil Krarup
• Land Camera – Edwin H. Land
• Langmuir probe – Irving Langmuir
• Leigh light – Humphrey de Verd Leigh
• Leotard – Jules Léotard
• Leslie speaker – Donald Leslie
• Lewis Gun – Isaac Newton Lewis
• Littlejohn adaptor – František Janeček
• Loganberry – James Harvey Logan
• Lyot filter, Lyot stop and Lyot depolarizer – Bernard Lyot
• Macadam, tarmac – John Loudon McAdam
• Machmeter – Ernst Mach
• Mackintosh – Charles Macintosh
• Mae West – Mae West
• Mallet's Mortar – Robert Mallet
• Manby Mortar – George William Manby
• Mansard roof – François Mansart
• Marconi rig – Guglielmo Marconi
• Mason jar – John Landis Mason
• Masonite – William H. Mason
• Mausoleum – Mausolus
• Maxim gun – Hiram Stevens Maxim
• McCormick reaper – Cyrus McCormick
• Melba toast, Peach Melba, Melba sauce – Nellie Melba
• Melvillade – Robert Melville
• Mercator projection – Gerardus Mercator
• Mercerised cotton – John Mercer
• Michelson interferometer – Albert Abraham Michelson
• Mills bomb – William Mills
• Minié ball, Minié rifle – Claude-Étienne Minié
• Molotov cocktail – Vyacheslav Molotov
• Momsen Lung, Charles B. Momsen
• Moog synthesizer – Robert Moog
• Morse code – Samuel Morse
• Muntz metal – George Frederic Muntz
• Murphy bed - William Lawrence Murphy
• Napier's bones – John Napier
• Newcomen steam engine – Thomas Newcomen
• Newtonian telescope – Isaac Newton
• Newton's Cradle - Isaac Newton
• Nissen hut – Peter Norman Nissen
• Nordenfelt gun – Thorsten Nordenfelt
• Northrop Loom – James Henry Northrop
• Odhner Arithmometer – Willgodt Theophil Odhner
• Odón device – Jorge Odón
• Ormerod link – Edward Ormerod
• Ostwald viscometer – Wilhelm Ostwald
• Owen submachine gun – Evelyn Owen
• Parkesine – Alexander Parkes
• Pasteurization – Louis Pasteur
• Patchett gun – George William Patchett
• Pavlova – Anna Pavlova
• Payne's grey – William Payne
• Peavey – Joseph Peavey
• Pelton turbine – Lester Allan Pelton
• Penning trap – Frans Michel Penning
• Petri dish – Julius Richard Petri
• Phillips screw – Henry F. Phillips
• Pilates – Joseph Pilates
• Pimm's – James Pimm
• Pinchbeck – Christopher Pinchbeck
• Pintsch gas – Julius Pintsch
• Pitman shorthand – Isaac Pitman
• Pitot tube – Henri Pitot
• Plimsoll line – Samuel Plimsoll
• Prince Rupert's Drop – Prince Rupert of the Rhine
• Pulaski – Ed Pulaski
• Pupin coil – Mihajlo Idvorski Pupin
• Puretic power block – Mario Puratić
• Prusik – Karl Prusik
• Raglan sleeve – Fitzroy Somerset, 1st Baron Raglan
• Raman spectroscopy – C. V. Raman
• Rawlplug – John Joseph Rawlings
• Richter magnitude scale – Charles Francis Richter
• Ripley machine gun – Ezra Ripley
• Rorschach test – Hermann Rorschach
• Rozière balloon – Jean-François Pilâtre de Rozier
• Rubik's Cube – Ernő Rubik
• Rumford fireplace – Benjamin Thompson
• Salk vaccine – Jonas Salk
• Salter's duck – Stephen Salter
• Sam Browne belt – Sam Browne
• Sandwich – Earl of Sandwich
• Savery engine – Thomas Savery
• Saxophone – Adolphe Sax
• Scavenger's daughter – Leonard Skeffington (or Skevington)
• Scheele's Green – Carl Wilhelm Scheele
- Schick test – Béla Schick
- Shrapnel shell – Henry Shrapnel
- Sousaphone – John Philip Sousa
- Southern blot – Edwin Southern
- Soyer stove – Alexis Soyer
- Spragg Bag – Terry Spragg
- Sprengel explosives, Sprengel Pump – Hermann Sprengel
- Stabinger viscometer – Hans Stabinger
- Stanhope – Henry FitzRoy Stanhope
- Stark spectroscopy – Johannes Stark
- Stelzer engine – Frank Stelzer
- Sten – Reginald V. Shepherd, Harold Turpin, Enfield
- Stetson – John Batterson Stetson
- Stiefografie – Helmut Stief
- Stillson wrench – Daniel Chapman Stillson
- Stirling engine – Rev. Robert Stirling
- Stockbridge damper – George H. Stockbridge
- Stokes mortar – Wilfred Stokes
- Strowger switch – Almon Brown Strowger
- Swallow float – John C. Swallow
- Tesla coil, Tesla turbine – Nikola Tesla
- Theremin – Léon Theremin
- Thompson submachine gun – John T. Thompson
- Tobin tax — James Tobin
- Tupperware – Earl Silas Tupper
- UbbeLohde viscometer – Leo UbbeLohde
- Uzi – Uziel Gal
- Venn diagram – John Venn
- Vernier scale – Pierre Vernier
- Very pistol, Very flare – Edward Wilson Very
- Vigreux column – Henri Vigreux
- Voltacic pile – Alessandro Volta
- Wagner tuba – Richard Wagner
- Wankel engine – Felix Wankel
- Wardian case – Nathaniel Bagshaw Ward
- Waterhouse stop – John Waterhouse
- Watt's linkage & Watt steam engine – James Watt
- Wedgwood porcelain – Wedgwood family
- Welin breech block – Axel Welin
- Wellington boot – Duke of Wellington
- Wells turbine – Alan Arthur Wells
- Westinghouse air brake – George Westinghouse
- Weston cell – Edward Weston
- Wheatstone bridge – Charles Wheatstone
- Whitehead Torpedo – Robert Whitehead
- Whitworth thread – Joseph Whitworth
- Wiegand wire – John R. Wiegand
- Wilhelmy plate – Ludwig Wilhelmy
- Wilson chamber – Charles Thomson Rees Wilson
- Winchester rifle – Oliver Winchester
- Windsor knot – Edward VII of the United Kingdom
- Winogradsky column – Sergei Winogradsky
- Wollaston landscape lens – William Hyde Wollaston
- Wollaston wire – William Hyde Wollaston
- Woodruff key – W.N. Woodruff
- Wood's glass – Robert W. Wood
- Yablochkov candle – Pavel Yablochkov
- Yale lock – Linus Yale, Jr.
- Zamboni – Frank Zamboni
- Zamboni pile – Giuseppe Zamboni
Zeppelin – Ferdinand von Zeppelin

List of inventions named after places

- Adirondack chair - Adirondack mountains, USA
- Adirondack guideboat - Adirondack mountains, USA
- Angostura bitters - Angostura, now called Ciudad Bolivar, Venezuela
- Arbroath smokie - Arbroath, Scotland
- Axminster carpet - Axminster, Somerset, UK
- Badminton game - Badminton, Gloucestershire, UK
- Bahian guitar - Bahia, Brazil
- Bakewell tart - Bakewell, Derbyshire, UK
- Balaclava - Balaklava, Crimea, Ukraine
- Balmoral bonnet - Balmoral, Scotland
- Balmoral shoe - Balmoral, Scotland
- Bánh mì - Saigon, Vietnam
- Bangalore torpedo - Bangalore, India
- Bath bun - Bath, Somerset, UK
- Belfast truss - Belfast, Northern Ireland
- Berlin - Berlin, Germany
- Bikini - Bikini Atoll, Marshall Islands
- Blackpool rock - Blackpool, Lancashire, UK
- Bordeaux mixture - Bordeaux, France
- Bristol board - Bristol, UK
- Brummagem Ware - Birmingham, UK
- Bungalow - Bengal, India
- Cambric - Cambrai, France known as Kameryk in Dutch
- Camembert - Camembert, Orne, France
- Calico - Kozhikode, Kerala, India known as Calicut
- Cape cart - Cape of Good Hope
- Champagne - Champagne, France
- Chelsea bun - Chelsea, London, UK
- Chorley cake - Chorley, Lancashire, UK
- Chicago screw - Chicago, Illinois, USA
- Cognac - Cognac, France
- Concord coach - Concord, New Hampshire, USA
- Corinthian bronze - Corinth, Greece
- Cornish pasty - Cornwall, UK
- Damascus steel - Damascus, Syria
- Damask - Damascus, Syria
- Delftware - Delft, Netherlands
- Denim - Nimes, France
- Dresden porcelain - Dresden, Germany
- Denver boot - Denver, USA
- Duffel Bag - Duffel, Belgium
- Dum-dum bullet - Dum Dum, West Bengal, India
- Dymkovo toy - Dymkovo settlement, Russia
- Eccles cake - Eccles, Greater Manchester, UK
- Elswick cruiser - Elswick, Tyne and Wear
- Eton crop - Eton, Berkshire, UK
- Eton mess - Eton College, Eton, Berkshire, UK
- Fedoskino miniature - Fedoskino, Russia
- Fez - Fez, Morocco
- Finnan haddie - Findon, Aberdeenshire, Scotland
- Frankfurter - Frankfurt, Germany
- Gordian knot - Gordium, Turkey
- Hackney carriage - Hackney, London
- Hamburger - Hamburg, Germany
- Harris tweed - Harris, Outer Hebrides, Scotland
- Homburg - Bad Homburg, Germany
• Jeans - Genoa, Italy
• Jodhpurs - Jodhpur, India
• Jena glass - Jena, Germany
• Jersey barrier - New Jersey, USA
• Jersey (clothing), Jersey (fabric) - Jersey
• Kentucky rifle - Kentucky, USA
• Khokhloma - Khokhloma settlement, Nizhny Novgorod Oblast, Russia
• Lancashire boiler - Lancashire, UK
• Landau - Landau, Germany
• Leyden jar - Leiden, Netherlands
• Limerick - Limerick, Ireland
• Limousine - Limousin, France
• Lincoln green - Lincoln, UK
• Macassar oil - Makassar, Indonesia
• Magenta - Magenta, Lombardy
• Marathon race - Marathon, Greece
• Mayonnaise - Mahón, Menorca, Spain
• Muscovy glass - Moscow, Russia
• Nankeen - Nanking, China
• Norfolk wherry - Norfolk, UK
• Orenburg shawl - Orenburg, Russia
• Oxford bags - Oxford, UK
• Oxford brogues - Oxford, UK
• Panama hat - Panama
• Paris Green - Paris, France
• Parchment - Pergamon, Turkey
• Pilsner beer - Pilsen, Czech Republic
• Plaster of Paris - Paris, France
• Polonium - Poland
• Pomfret Cakes - Pontefract, Yorkshire, UK
Lists of unsolved problems in Science

Physics:

- Theory of everything: Is there a theory which explains the values of all fundamental physical constants, i.e., of all coupling constants, all elementary particle masses and all mixing angles of elementary particles? Is there a theory which explains why the gauge groups of the standard model are as they are, and why observed spacetime has 3 spatial dimensions and 1 temporal dimension? Are "fundamental physical constants" really fundamental or do they vary over time? Are any of the fundamental particles in the standard model of particle physics actually composite particles too tightly bound to observe as such at
current experimental energies? Are there elementary particles that have not yet been observed, and, if so, which ones are they and what are their properties? Are there unobserved fundamental forces?

- Arrow of time (e.g. entropy's arrow of time): Why does time have a direction? Why did the universe have such low entropy in the past, and time correlates with the universal (but not local) increase in entropy, from the past and to the future, according to the second law of thermodynamics? Why are CP violations observed in certain weak force decays, but not elsewhere? Are CP violations somehow a product of the second law of thermodynamics, or are they a separate arrow of time? Are there exceptions to the principle of causality? Is there a single possible past? Is the present moment physically distinct from the past and future, or is it merely an emergent property of consciousness? What links the quantum arrow of time to the thermodynamic arrow?

- Interpretation of quantum mechanics: How does the quantum description of reality, which includes elements such as the superposition of states and wavefunction collapse or quantum decoherence, give rise to the reality we perceive? Another way of stating this question regards the measurement problem: What constitutes a "measurement" which apparently causes the wave function to collapse into a definite state? Unlike classical physical processes, some quantum mechanical processes (such as quantum teleportation arising from quantum entanglement) cannot be simultaneously "local", "causal", and "real", but it is not obvious which of these properties must be sacrificed, or if an attempt to describe quantum mechanical processes in these senses is a category error such that a proper understanding of quantum mechanics would render the question meaningless. Can a multiverse resolve it?

- Yang–Mills theory: Given an arbitrary compact gauge group, does a non-trivial quantum Yang–Mills theory with a finite mass gap exist? (This problem is also listed as one of the Millennium Prize Problems in mathematics.)

- Color confinement: Quantum chromodynamics (QCD) color confinement conjecture is that color charged particles (such as quarks and gluons) cannot be separated from their parent hadron without producing new hadrons. There is not yet an analytic proof of color confinement in any non-abelian gauge theory.

- Physical information: Are there physical phenomena, such as wave function collapse or black holes, that irrevocably destroy information about their prior states? How is quantum information stored as a state of a quantum system?

- Dimensionless physical constant: At the present time, the values of the dimensionless physical constants cannot be calculated; they are determined only by physical measurement. What is the minimum number of dimensionless physical constants from which all other dimensionless physical constants can be derived? Are dimensional physical constants necessary at all?

- Fine-tuned universe: The values of the fundamental physical constants are in a narrow range necessary to support carbon-based life. Is this because there exist other universes with different constants, or are our
universe's constants the result of chance, or some other factor or process? In particular, Tegmark's mathematical multiverse hypothesis of abstract mathematical parallel universe formalized models, and the landscape multiverse hypothesis of spacetime regions having different formalized sets of laws and physical constants from that of the surrounding space — require formalization.

- Quantum field theory: Is it possible to construct, in the mathematically rigorous framework of algebraic QFT, a theory in 4-dimensional spacetime that includes interactions and does not resort to perturbative methods?

- Problem of time: In quantum mechanics time is a classical background parameter and the flow of time is universal and absolute. In general relativity time is one component of four-dimensional spacetime, and the flow of time changes depending on the curvature of spacetime and the spacetime trajectory of the observer. How can these two concepts of time be reconciled?

- Cosmic inflation: Is the theory of cosmic inflation in the very early universe correct, and, if so, what are the details of this epoch? What is the hypothetical inflaton scalar field that gave rise to this cosmic inflation? If inflation happened at one point, is it self-sustaining through inflation of quantum-mechanical fluctuations, and thus ongoing in some extremely distant place?

- Horizon problem: Why is the distant universe so homogeneous when the Big Bang theory seems to predict larger measurable anisotropies of the night sky than those observed? Cosmological inflation is generally accepted as the solution, but are other possible explanations such as a variable speed of light more appropriate?

- Origin and future of the universe: How did the conditions for anything to exist arise? Is the universe heading towards a Big Freeze, a Big Rip, a Big Crunch, or a Big Bounce? Or is it part of an infinitely recurring cyclic model?

- Size of universe: The diameter of the observable universe is about 93 billion light-years, but what is the size of the whole universe?

- Baryon asymmetry: Why is there far more matter than antimatter in the observable universe?

- Cosmological constant problem: Why does the zero-point energy of the vacuum not cause a large cosmological constant? What cancels it out?

- Dark matter: What is the identity of dark matter? Is it a particle? Is it the lightest superpartner (LSP)? Or, do the phenomena attributed to dark matter point not to some form of matter but actually to an extension of gravity?

- Dark energy: What is the cause of the observed accelerated expansion (de Sitter phase) of the universe? Why is the energy density of the dark energy component of the same magnitude as the density of matter at present when the two evolve quite differently over time; could it be simply that we are observing at exactly the right time? Is dark energy a pure cosmological constant or are models of quintessence such as phantom energy applicable?
• Dark flow: Is a non-spherically symmetric gravitational pull from outside the observable universe responsible for some of the observed motion of large objects such as galactic clusters in the universe?

• Axis of evil: Some large features of the microwave sky at distances of over 13 billion light years appear to be aligned with both the motion and orientation of the solar system. Is this due to systematic errors in processing, contamination of results by local effects, or an unexplained violation of the Copernican principle?

• Shape of the universe: What is the 3-manifold of comoving space, i.e. of a comoving spatial section of the universe, informally called the "shape" of the universe? Neither the curvature nor the topology is presently known, though the curvature is known to be "close" to zero on observable scales. The cosmic inflation hypothesis suggests that the shape of the universe may be unmeasurable, but, since 2003, Jean-Pierre Luminet, et al., and other groups have suggested that the shape of the universe may be the Poincaré dodecahedral space. Is the shape unmeasurable; the Poincaré space; or another 3-manifold?

• The largest structures in the universe are larger than expected. Current cosmological models say there should be very little structure on scales larger than a few hundred million light years across, due to the expansion of the universe trumping the effect of gravity. But the Sloan Great Wall is 1.38 billion light-years in length. And the largest structure currently known, the Hercules–Corona Borealis Great Wall, is up to 10 billion light-years in length. Are these actual structures or random density fluctuations? If they are real structures, they contradict the 'End of Greatness' hypothesis which asserts that at a scale of 300 million light-years structures seen in smaller surveys are randomized to the extent that the smooth distribution of the universe is visually apparent.

• Vacuum catastrophe: Why does the predicted mass of the quantum vacuum have little effect on the expansion of the universe?

• Quantum gravity: Can quantum mechanics and general relativity be realized as a fully consistent theory (perhaps as a quantum field theory)? Is spacetime fundamentally continuous or discrete? Would a consistent theory involve a force mediated by a hypothetical graviton, or be a product of a discrete structure of spacetime itself (as in loop quantum gravity)? Are there deviations from the predictions of general relativity at very small or very large scales or in other extreme circumstances that flow from a quantum gravity theory?

• Black holes, black hole information paradox, and black hole radiation: Do black holes produce thermal radiation, as expected on theoretical grounds? Does this radiation contain information about their inner structure, as suggested by gauge–gravity duality, or not, as implied by Hawking's original calculation? If not, and black holes can evaporate away, what happens to the information stored in them (since quantum mechanics does not provide for the destruction of information)? Or does the radiation stop at some point leaving black hole remnants? Is there another way to probe their internal structure somehow, if such a structure even exists?
Extra dimensions: Does nature have more than four spacetime dimensions? If so, what is their size? Are dimensions a fundamental property of the universe or an emergent result of other physical laws? Can we experimentally observe evidence of higher spatial dimensions?

The cosmic censorship hypothesis and the chronology protection conjecture: Can singularities not hidden behind an event horizon, known as "naked singularities", arise from realistic initial conditions, or is it possible to prove some version of the "cosmic censorship hypothesis" of Roger Penrose which proposes that this is impossible? Similarly, will the closed timelike curves which arise in some solutions to the equations of general relativity (and which imply the possibility of backwards time travel) be ruled out by a theory of quantum gravity which unites general relativity with quantum mechanics, as suggested by the "chronology protection conjecture" of Stephen Hawking?

Locality: Are there non-local phenomena in quantum physics? If they exist, are non-local phenomena limited to the entanglement revealed in the violations of the Bell inequalities, or can information and conserved quantities also move in a non-local way? Under what circumstances are non-local phenomena observed? What does the existence or absence of non-local phenomena imply about the fundamental structure of spacetime? How does this elucidate the proper interpretation of the fundamental nature of quantum physics?

Hierarchy problem: Why is gravity such a weak force? It becomes strong for particles only at the Planck scale, around $10^{19}$ GeV, much above the electroweak scale (100 GeV, the energy scale dominating physics at low energies). Why are these scales so different from each other? What prevents quantities at the electroweak scale, such as the Higgs boson mass, from getting quantum corrections on the order of the Planck scale? Is the solution supersymmetry, extra dimensions, or just anthropic fine-tuning?

Planck particle: The Planck mass plays an important role in parts of mathematical physics. A series of researchers have suggested the existence of a fundamental particle with mass equal to or close to that of the Planck mass. The Planck mass is however enormous compared to any detected particle. It is still an unsolved problem if there exist or even have existed a particle with close to the Planck mass. This is indirectly related to the hierarchy problem.

Magnetic monopoles: Did particles that carry "magnetic charge" exist in some past, higher-energy epoch? If so, do any remain today? (Paul Dirac showed the existence of some types of magnetic monopoles would explain charge quantization.)

Neutron lifetime puzzle: While the neutron lifetime has been studied for decades, there currently exists a lack of consilience on its exact value, due to different results from two experimental methods ("bottle" versus "beam").

Proton decay and spin crisis: Is the proton fundamentally stable? Or does it decay with a finite lifetime as predicted by some extensions to the standard model? How do the quarks and gluons carry the spin of protons?
• Supersymmetry: **Is spacetime supersymmetry realized at TeV scale?** If so, what is the mechanism of supersymmetry breaking? Does supersymmetry stabilize the electroweak scale, preventing high quantum corrections? Does the lightest supersymmetric particle (LSP or Lightest Supersymmetric Particle) comprise dark matter?

• Generations of matter: Why are there three generations of quarks and leptons? Is there a theory that can explain the masses of particular quarks and leptons in particular generations from first principles (a theory of Yukawa couplings)?

• Neutrino mass: What is the mass of neutrinos, whether they follow Dirac or Majorana statistics? Is the mass hierarchy normal or inverted? Is the CP violating phase equal to 0?

• Strong CP problem and axions: Why is the strong nuclear interaction invariant to parity and charge conjugation? Is Peccei–Quinn theory the solution to this problem? Could axions be the main component of dark matter?

• Anomalous magnetic dipole moment: Why is the experimentally measured value of the muon's anomalous magnetic dipole moment ("muon g–2") significantly different from the theoretically predicted value of that physical constant?

• Proton radius puzzle: What is the electric charge radius of the proton? How does it differ from gluonic charge?

• Pentaquarks and other exotic hadrons: What combinations of quarks are possible? Why were pentaquarks so difficult to discover? Are they a tightly-bound system of five elementary particles, or a more weakly-bound pairing of a baryon and a meson?

• Mu problem: problem of supersymmetric theories, concerned with understanding the parameters of the theory.

• Koide formula: An aspect of the problem of particle generations. The sum of the masses of the three charged leptons, divided by the square of the sum of the roots of these masses, to within one standard deviation of observations, is \( Q = \frac{2}{3} \). It is unknown how such a simple value comes about, and why it is the exact arithmetic average of the possible extreme values of \( 1/3 \) (equal masses) and \( 1 \) (one mass dominates).

• Astrophysical jet: Why do only certain accretion discs surrounding certain astronomical objects emit relativistic jets along their polar axes? Why are there quasi-periodic oscillations in many accretion discs? Why does the period of these oscillations scale as the inverse of the mass of the central object? Why are there sometimes overtones, and why do these appear at different frequency ratios in different objects?

• Diffuse interstellar bands: What is responsible for the numerous interstellar absorption lines detected in astronomical spectra? Are they molecular in origin, and if so which molecules are responsible for them? How do they form?
Supermassive black holes: What is the origin of the M-sigma relation between supermassive black hole mass and galaxy velocity dispersion? How did the most distant quasars grow their supermassive black holes up to $10^{10}$ solar masses so early in the history of the universe?

Kuiper cliff: Why does the number of objects in the Solar System's Kuiper belt fall off rapidly and unexpectedly beyond a radius of 50 astronomical units?

Flyby anomaly: Why is the observed energy of satellites flying by planetary bodies sometimes different by a minute amount from the value predicted by theory?

Galaxy rotation problem: Is dark matter responsible for differences in observed and theoretical speed of stars revolving around the centre of galaxies, or is it something else?

Supernovae: What is the exact mechanism by which an implosion of a dying star becomes an explosion?

p-nuclei: What astrophysical process is responsible for the nucleogenesis of these rare isotopes?

Ultra-high-energy cosmic ray: Why is it that some cosmic rays appear to possess energies that are impossibly high, given that there are no sufficiently energetic cosmic ray sources near the Earth? Why is it that (apparently) some cosmic rays emitted by distant sources have energies above the Greisen–Zatsepin–Kuzmin limit?

Rotation rate of Saturn: Why does the magnetosphere of Saturn exhibit a (slowly changing) periodicity close to that at which the planet's clouds rotate? What is the true rotation rate of Saturn's deep interior?

Origin of magnetar magnetic field: What is the origin of magnetar magnetic field?

Large-scale anisotropy: Is the universe at very large scales anisotropic, making the cosmological principle an invalid assumption? The number count and intensity dipole anisotropy in radio, NRAO VLA Sky Survey (NVSS) catalogue is inconsistent with the local motion as derived from cosmic microwave background and indicate an intrinsic dipole anisotropy. The same NVSS radio data also shows an intrinsic dipole in polarization density and degree of polarization in the same direction as in number count and intensity. There are several other observation revealing large-scale anisotropy. The optical polarization from quasars shows polarization alignment over a very large scale of Gpc. The cosmic-microwave-background data shows several features of anisotropy, which are not consistent with the Big Bang model.

Age–metallicity relation in the Galactic disk: Is there a universal age–metallicity relation (AMR) in the Galactic disk (both "thin" and "thick" parts of the disk)? Although in the local (primarily thin) disk of the Milky Way there is no evidence of a strong AMR, a sample of 229 nearby "thick" disk stars has been used to investigate the existence of an age–metallicity relation in the Galactic thick disk, and indicate that there is an age–metallicity relation present in the thick disk. Stellar ages from asteroseismology confirm the lack of any strong age-metallicity relation in the Galactic disc.

The lithium problem: Why is there a discrepancy between the amount of lithium-7 predicted to be produced in Big Bang nucleosynthesis and the amount observed in very old stars?
• Ultraluminous X-ray sources (ULXs): What powers X-ray sources that are not associated with active
galactic nuclei but exceed the Eddington limit of a neutron star or stellar black hole? Are they due
to intermediate mass black holes? Some ULXs are periodic, suggesting non-isotropic emission from a
neutron star. Does this apply to all ULXs? How could such a system form and remain stable?

• Fast radio bursts (FRBs): What causes these transient radio pulses from distant galaxies, lasting only a few
milliseconds each? Why do some FRBs repeat at unpredictable intervals, but most do not? Dozens of
models have been proposed, but none have been widely accepted.

• Quantum chromodynamics: What are the phases of strongly interacting matter, and what roles do they play
in the evolution of cosmos? What is the detailed partonic structure of the nucleons? What does QCD
predict for the properties of strongly interacting matter? What determines the key features of QCD, and
what is their relation to the nature of gravity and spacetime? Do glueballs exist? Do gluons acquire mass
dynamically despite having a zero rest mass, within hadrons? Does QCD truly lack CP-violations? Do
 gluons saturate when their occupation number is large? Do gluons form a dense system called Colour Glass
Condensate? What are the signatures and evidences for the Balitsky-Fadin-Kuarev-Lipatov, Balitsky-
Kovchegov, Catani-Ciafaloni-Fiorani-Marchesini evolution equations?

• Nuclei and nuclear astrophysics: Why is there a lack of convergence in estimates of the mean lifetime of a
free neutron based on two separate- and increasingly precise- experimental methods? What is the nature of
the nuclear force that binds protons and neutrons into stable nuclei and rare isotopes? What is the nature of
exotic excitations in nuclei at the frontiers of stability and their role in stellar processes? What is the nature
of neutron stars and dense nuclear matter? What is the origin of the elements in the cosmos? What are the
nuclear reactions that drive stars and stellar explosions? What is the heaviest possible chemical element?

• Abraham-Minkowski controversy: What is the momentum of light in optical media? Whether Abraham's or
Minkowski's momentum is right?

• Bose–Einstein condensation: How do we rigorously prove the existence of Bose–Einstein condensates for
general interacting systems?

• Singular trajectories in the Newtonian N-body problem: Does the set of initial conditions for which
particles that undergo near-collisions gain infinite speed in finite time have measure zero? This is known to
be the case when $N \leq 4$, but the question remains open for larger $N$.

• The Navier-Stokes equation explains Fluid dynamics. Although this equation was discovered in the 19th
century, the existence of solutions and their proof are still not well established.

• Turbulence: Is it possible to make a theoretical model to describe the statistics of a turbulent flow (in
particular, its internal structures)? Also, under what conditions do smooth solutions to the Navier–Stokes
equations exist? The latter problem is also listed as one of the Millennium Prize Problems in mathematics.

• Stochasticity and robustness to noise in gene expression: How do genes govern our body, withstanding
different external pressures and internal stochasticity? Certain models exist for genetic processes, but we
are far from understanding the whole picture, in particular in development where gene expression must be tightly regulated.

- Memory: How is long-term memory stored on a biological substrate undergoing constant turnover?
- Quantitative study of the immune system: What are the quantitative properties of immune responses? What are the basic building blocks of immune system networks?
- Unified brain processing theory: How to unify physics and neuroscience?
- Homochirality: What is the origin of the preponderance of specific enantiomers in biochemical systems?
- Magnetoreception: How do animals (e.g. migratory birds) sense the Earth's magnetic field?
- Plasma physics and fusion power: Fusion energy may potentially provide power from abundant resource (e.g. hydrogen) without the type of radioactive waste that fission energy currently produces. However, can ionized gases (plasma) be confined long enough and at a high enough temperature to create fusion power? What is the physical origin of H-mode?
- Solar cycle: How does the Sun generate its periodically reversing large-scale magnetic field? How do other solar-like stars generate their magnetic fields, and what are the similarities and differences between stellar activity cycles and that of the Sun? What caused the Maunder Minimum and other grand minima, and how does the solar cycle recover from a minima state?
- Coronal heating problem: Why is the Sun's corona (atmosphere layer) so much hotter than the Sun's surface? Why is the magnetic reconnection effect many orders of magnitude faster than predicted by standard models?
- The injection problem: Fermi acceleration is thought to be the primary mechanism that accelerates astrophysical particles to high energy. However, it is unclear what mechanism causes those particles to initially have energies high enough for Fermi acceleration to work on them.
- Solar wind interaction with comets: In 2007 the Ulysses spacecraft passed through the tail of comet C/2006 P1 (McNaught) and found surprising results concerning the interaction of the solar wind with the tail.
- Alfvénic turbulence: In the solar wind and the turbulence in solar flares, coronal mass ejections, and magnetospheric substorms are major unsolved problems in space plasma physics.
- High-temperature superconductors: What is the mechanism that causes certain materials to exhibit superconductivity at temperatures much higher than around 25 kelvins? Is it possible to make a material that is a superconductor at room temperature?
- Amorphous solids: What is the nature of the glass transition between a fluid or regular solid and a glassy phase? What are the physical processes giving rise to the general properties of glasses and the glass transition?
- Cryogenic electron emission: Why does the electron emission in the absence of light increase as the temperature of a photomultiplier is decreased?
Sonoluminescence: What causes the emission of short bursts of light from imploding bubbles in a liquid when excited by sound?

Topological order: Is topological order stable at non-zero temperature? Equivalently, is it possible to have three-dimensional self-correcting quantum memory?

Fractional Hall effect: What mechanism explains the existence of the $u = 5/2$ state in the fractional quantum Hall effect? Does it describe quasiparticles with non-Abelian fractional statistics?

Liquid crystals: Can the nematic to smectic (A) phase transition in liquid crystal states be characterized as a universal phase transition?

Semiconductor nanocrystals: What is the cause of the nonparabolicity of the energy-size dependence for the lowest optical absorption transition of quantum dots?

Metal whiskering: In electrical devices, some metallic surfaces may spontaneously grow fine metallic whiskers, which can lead to equipment failures. While compressive mechanical stress is known to encourage whisker formation, the growth mechanism has yet to be determined.

Chemistry:

What are the electronic structures of high-temperature superconductors at various points on their phase diagrams?

Can the transition temperature of high-temperature superconductors be brought up to room temperature?

Is Feynmanium the last chemical element that can physically exist? That is, what are the chemical consequences of having an element with an atomic number above 137, whose 1s electrons must travel faster than the speed of light?

Is Neutronium-4 possible?

How can electromagnetic energy (photons) be efficiently converted to chemical energy? For example, can water be efficiently split to hydrogen and oxygen using solar energy?

Is an abiologic origin of chirality as is found in $(2R)$-2,3-dihydroxypropanal (D-glyceraldehyde), and also in amino acids, sugars, etc., possible?

Why are accelerated kinetics observed for some organic reactions at the water-organic interface?

What is the origin of the alpha effect, that is, that nucleophiles with an electronegative atom with lone pairs adjacent to the nucleophilic center are particularly reactive?

Why do some enzymes exhibit faster-than-diffusion kinetics?

Is it possible to predict the secondary, tertiary and quaternary structure of a polypeptide sequence based solely on the sequence and environmental information? Inverse protein-folding problem: Is it possible to...
design a polypeptide sequence which will adopt a given structure under certain environmental conditions? This has been achieved for several small globular proteins in recent years.

- Is it possible to accurately predict the secondary, tertiary and quaternary structure of a polyribonucleic acid sequence based on its sequence and environment?
- What are the chemical origins of life? How did non-living chemical compounds generate self-replicating, complex life forms?
- Is it possible to design highly active enzymes de novo for any desired reaction?
- Can desired molecules, natural products or otherwise, be produced in high yield through biosynthetic pathway manipulation?

**Biology:**

- Exactly how and when did life on Earth originate? Which, if any, of the many hypotheses is correct?
- Exactly how and when did different groups of viruses originate?
- Might life which does not originate from planet Earth also have developed on other planets? Might this life be intelligent?
- What are the chemical origins of life? How did non-living chemical compounds generate self-replicating, complex life forms?
- What selective advantages drove the development of sexual reproduction, and how did it develop?
- What is the cause of homosexuality, especially in the human species?
- How and why did the brain evolve? What are the molecular determinants of individual brain development?
- How do cells determine what size to grow to before dividing?
- In cell theory, what is the exact transport mechanism by which proteins travel through the Golgi apparatus?
- The mechanisms of action of many drugs including paracetamol, lithium, thalidomide and ketamine are not completely understood.
- What is the folding code? What is the folding mechanism? Can we predict the native structure of a protein from its amino acid sequence? Is it possible to predict the secondary, tertiary and quaternary structure of a polypeptide sequence based solely on the sequence and environmental information? Inverse protein-folding problem: Is it possible to design a polypeptide sequence which will adopt a given structure under certain environmental conditions? This has been achieved for several small globular proteins in recent years.
- Why do some enzymes exhibit faster-than-diffusion kinetics?
• Is it possible to accurately predict the secondary, tertiary and quaternary structure of a polynucleic acid sequence based on its sequence and environment?
• Is it possible to design highly active enzymes \textit{de novo} for any desired reaction?
• Can desired molecules, natural products or otherwise, be produced in high yield through biosynthetic pathway manipulation?
• What is the \textbf{mechanism of allosteric transitions of proteins}? The concerted and sequential models have been hypothesised but neither has been verified.
• \textbf{How many genes do we have?}
• What are the \textbf{endogenous ligands of orphan receptors}?
• What substance is \textbf{endothelium-derived hyperpolarizing factor}?
• \textbf{Why does biological aging occur}? There are a number of hypotheses why senescence occurs including those that it is programmed by gene expression changes and that it is the accumulative damage of biological processes.
• \textbf{Consistency of movement}. How can we move so controllably, even though the motor nerve impulses seem haphazard and unpredictable?
• \textbf{How do organs grow to the correct shape and size}? How are the final shape and size of organs so reliably formed? These processes are in part controlled by the Hippo signaling pathway
• \textbf{Can developing biological systems tell the time}? To an extent, this appears to be the case, as shown by the \textit{CLOCK} gene.
• \textbf{Why are babies so rarely born with cancer}?
• The high diversity of phytoplankton seems to violate the competitive exclusion principle.
• What is the cause of the apparent rapid diversification of multicellular animal life around the beginning of the Cambrian, resulting in the emergence of almost all modern animal phyla?
• Why does biodiversity increase when going from the poles towards the equator?
• What is the exact evolutionary history of flowers and what is the cause of the apparently sudden appearance of nearly modern flowers in the fossil record?
• There are at least 100 species of this phylum of marine dwelling animals (many undescribed), but none of them is known to be present in the fossil record.
• \textbf{Adult form of Facetotecta}. The adult form of this animal has never been encountered in the water, and it remains a mystery to what it grows into.
• Did snakes evolve from burrowing lizards or aquatic lizards? There is evidence for both hypotheses.
• Did turtles evolve from anapsids or diapsids? There is evidence for both hypotheses.
• How should Ediacaran biota be classified? Even what kingdom they belong to is unclear. Why were they so decisively displaced by Cambrian biota?
• A satisfactory explanation for the neurobiological mechanisms that allow homing in animals has yet to be found.
• How do the descendants of monarch butterfly all over Canada and the US eventually, after migrating for several generations, manage to return to a few relatively small overwintering spots?
• There is not much data on the sexuality of the blue whale.
• It is largely unknown how gall wasps induce gall formation in plants; chemical, mechanical, and viral triggers have been discussed.
• Alkaloids. The function of these substances in living organisms which produce them is not known
• Korarchaeota (archaea). The metabolic processes of this phylum of archaea are so far unclear.
• What is the function of the retrocerebral organ of rotifers (pseudocoelomate animals)?
• Glycogen body. The function of this structure in the spinal cord of birds is not known.
• A long-standing zoological dispute concerning the segmental composition of the heads of the various arthropod groups, and how they are evolutionarily related to each other.
• Only the right ovary in female basking sharks appears to function. The reason is unknown.
• There is a long-standing debate over whether the primary function of the osteoderms/scutes of stegosaurs is protection from predators, sexual display, species recognition, thermoregulation, or other functions.
• What is the biological function of sleep? Why do we dream? What are the underlying brain mechanisms? What is its relation to anesthesia?
• How plastic is the mature brain?
• General anesthetic. What is the mechanism by which it works?
• What are the neural bases (causes) of mental diseases like psychotic disorders (e.g. mania, schizophrenia), Parkinson's disease, Alzheimer's disease, or addiction? Is it possible to recover loss of sensory or motor function?
• What are all the different types of neuron and what do they do in the brain?
• How and where does the brain evaluate reward value and effort (cost) to modulate behavior? How does previous experience alter perception and behavior? What are the genetic and environmental contributions to brain function?
• How important is the precise timing of action potentials for information processing in the neocortex? Is there a canonical computation performed by cortical columns? How is information in the brain processed
by the collective dynamics of large neuronal circuits? What level of simplification is suitable for a
description of information processing in the brain? What is the neural code?

- What are the limits of understanding thinking as a form of computing?
- What is the brain basis of subjective experience, cognition, wakefulness, alertness, arousal, and attention? Is there a "hard problem of consciousness"? If so, how is it solved? What, if any, is the function of consciousness?
- How does the brain transfer sensory information into coherent, private percepts? What are the rules by which perception is organized? What are the features/objects that constitute our perceptual experience of internal and external events? How are the senses integrated? What is the relationship between subjective experience and the physical world?
- Where do our memories get stored and how are they retrieved again? How can learning be improved? What is the difference between explicit and implicit memories? What molecule is responsible for synaptic tagging?
- What are the laws and mechanisms - of new idea emergence (insight, creativity synthesis, intuition, decision-making, eureka); development (evolution) of an individual mind in the ontogenesis, etc.?
- Language. How is it implemented neurally? What is the basis of semantic meaning?

Geoscience:

- How did Earth and other planets form? Were planets formed in situ? Or are orbital changes relatively frequent? What determined the different deep layering of the solar planets?
- Was there ever a collision of the Earth with another planet Theia, giving birth to our satellite? There is compelling evidence, such as measures of a shorter duration of the Earth's rotation and lunar month in the past, pointing to a Moon much closer to Earth during the early stages of the Solar System.
- What is the long-term heat balance of Earth? How did its internal temperature decay since it formed by accretion of chondrites? How abundant are radiogenic elements in the interior? Did a "faint young Sun" ever warm a "snowball Earth"?
- What made plate tectonics a dominant process only on Earth? How did the planet cool down before plate tectonics? Was the Earth's crust formed during the early stages of its evolution or is it the result of a gradual distillation of the mantle that continues today along with crustal recycling? Is the crust still growing or does its recycling compensate for crust formation at mid-ocean ridges and other volcanic areas?
- Can the now widely available topographic data be used to derive past tectonic and climatic conditions (in the multi-million year scale)? Do we know enough about the erosion and transport processes? Does the
stochasticity of meteorological and tectonic events reflect in the landscape? How much has life contributed to shape the Earth's surface?

- Can classical geomorphological concepts such as peneplanation or retrogressive erosion be quantitatively understood? Old mountain ranges such as the Appalachian or the Urals seem to retain relief for \( >10^8 \) years, while subglacial fluvial valleys under Antarctica are preserved under moving ice of kilometric thickness since the Neogene. What controls the time-scale of topographic decay?

- What are the erosion and transport laws governing the evolution of the Earth's Surface? Rivers transport sediment particles that are at the same time the tools for erosion but also the shield protecting the bedrock. How important is this double role of sediment for the evolution of landscapes?

- How resilient is the ocean to chemical perturbations?

- What caused the huge salt deposition in the Mediterranean known as the Messinian salinity crisis? Was the Mediterranean truly desiccated? What were the effects on climate and biology, and what can we learn from extreme salt giants like this? How were the normal marine conditions reestablished?

- What controls the dynamics of storm tracks?

- Mechanisms that cause oscillations in equatorial climate remain under intense study. The El Nino Southern Oscillation (ENSO) of the equatorial Pacific Ocean temperature is difficult to predict more than a few months in advance. The Quasi-Biennial Oscillation (QBO) of the equatorial stratospheric winds is somewhat regular at \(~28\) months but the cause has been heavily debated. Are these stochastic, chaotic, or deterministically forced behaviors?

- What are skyquakes?

- The 'space problem': How are granite magma chambers emplaced in the crust? What are the structures and locations of the magmatic systems that might cause supervolcanoes? What are the viscosities and densities of the magma chambers and the details of magma migration?

- What are the non-uniformities and rheological details of the mantle? What is the structure of the 660 km discontinuity and its relation to the correct model of the polar drift?

- What is the precise nature of chemical heterogeneity associated with the Gutenberg discontinuity?

- What are the light alloying elements in the Earth's outer core and how are they distributed? What are the heterogeneities of the core and their dynamical significance?

- Does the internal mantle structure provide the resonance for the Chandler wobble of the earth's axis or is it some other external mechanism? No available motions seem to be coherent drivers for the wobble period of 433 days.
Neuroscience:

- **Consciousness**: What is the neural basis of subjective experience, cognition, wakefulness, alertness, arousal, and attention? Is there a "hard problem of consciousness"? If so, how is it solved? What, if any, is the function of consciousness?

- **Perception**: How does the brain transfer sensory information into coherent, private percepts? What are the rules by which perception is organized? What are the features/objects that constitute our perceptual experience of internal and external events? How are the senses integrated? What is the relationship between subjective experience and the physical world?

- **Learning and memory**: Where do our memories get stored and how are they retrieved again? How can learning be improved? What is the difference between explicit and implicit memories? What molecule is responsible for synaptic tagging?

- **Neuroplasticity**: How plastic is the mature brain?

- **Development and evolution**: How and why did the brain evolve? What are the molecular determinants of individual brain development?

- **Free will, particularly the neuroscience of free will**

- **Sleep**: What is the biological function of sleep? Why do we dream? What are the underlying brain mechanisms? What is its relation to anesthesia?

- **Cognition and decisions**: How and where does the brain evaluate reward value and effort (cost) to modulate behavior? How does previous experience alter perception and behavior? What are the genetic and environmental contributions to brain function?

- **Language**: How is it implemented neurally? What is the basis of semantic meaning?

- **Diseases**: What are the neural bases (causes) of mental diseases like psychotic disorders (e.g. mania, schizophrenia), Amyotrophic lateral sclerosis, Parkinson's disease, Alzheimer's disease, or addiction? Is it possible to recover loss of sensory or motor function?

- **Movement**: How can we move so controllably, even though the motor nerve impulses seem haphazard and unpredictable?

- **Computational theory of mind**: What are the limits of understanding thinking as a form of computing?

- **Computational neuroscience**: How important is the precise timing of action potentials for information processing in the neocortex? Is there a canonical computation performed by cortical columns? How is information in the brain processed by the collective dynamics of large neuronal circuits? What level of simplification is suitable for a description of information processing in the brain? What is the neural code?

- **How does general anesthetic work?**

- **Neural computation**: What are all the different types of neuron and what do they do in the human brain?
- Noogenesis - the emergence and evolution of intelligence: What are the laws and mechanisms of new idea emergence (insight, creativity synthesis, intuition, decision-making, eureka); development (evolution) of an individual mind in the ontogenesis, etc.?

**Computer Science:**

- P versus NP problem
- What is the relationship between BQP and NP?
- NC = P problem
- NP = co-NP problem
- P = BPP problem
- P = PSPACE problem
- L = NL problem
- PH = PSPACE problem
- L = P problem
- L = RL problem
- Unique games conjecture
- Is the exponential time hypothesis true?
- Is the strong exponential time hypothesis (SETH) true?
- Do one-way functions exist?
- Is public-key cryptography possible?
- Log-rank conjecture
- Can integer factorization be done in polynomial time on a classical (non-quantum) computer?
- Can clustered planar drawings be found in polynomial time?
- Can the discrete logarithm be computed in polynomial time?
- Can the graph isomorphism problem be solved in polynomial time?
- Can leaf powers and k-leaf powers be recognized in polynomial time?
- Can parity games be solved in polynomial time?
- Can the rotation distance between two binary trees be computed in polynomial time?
- Can graphs of bounded clique-width be recognized in polynomial time?
- Can one find a simple closed quasigeodesic on a convex polyhedron in polynomial time?
• Can a simultaneous embedding with fixed edges for two given graphs be found in polynomial time?
• The dynamic optimality conjecture: do splay trees have a bounded competitive ratio?
• Is there a k-competitive online algorithm for the k-server problem?
• Can a depth-first search tree be constructed in NC?
• Can the fast Fourier transform be computed in $o(n \log n)$ time?
• What is the fastest algorithm for multiplication of two $n$-digit numbers?
• What is the lowest possible average-case time complexity of Shellsort with a deterministic, fixed gap sequence?
• Can 3SUM be solved in strongly sub-quadratic time, that is, in time $O(n^{2.5})$ for some $c>0$?
• Can the edit distance between two strings of length $n$ be computed in strongly sub-quadratic time? (This is only possible if the strong exponential time hypothesis is false.)
• Can $X + Y$ sorting be done in $o(n^2 \log n)$ time?
• What is the fastest algorithm for matrix multiplication?
• Can all-pairs shortest paths be computed in strongly sub-cubic time, that is, in time $O(V^{3.5})$ for some $c>0$?
• Can the Schwartz–Zippel lemma for polynomial identity testing be derandomized?
• Does linear programming admit a strongly polynomial-time algorithm?
• How many queries are required for envy-free cake-cutting?
• What is the algorithm for the lookup table that consistently generates playable mazes in the 1982 Atari 2600 game Entombed merely from the values of the five pixels adjacent to the next ones to be generated?
• Is there any perfect syllabification algorithm in the English language?
• Is there any perfect stemming algorithm in the English language?
• Is there any perfect POS tagging algorithm in the English language?

Statistics:

• How to detect and correct for **systematic errors**, especially in sciences where random errors are large (a situation Tukey termed uncomfortable science).
• The Graybill–Deal estimator is often used to estimate the common mean of two normal populations with unknown and possibly unequal variances. Though this estimator is generally unbiased, its admissibility remains to be shown.
• **Meta-analysis**: Though independent p-values can be combined using Fisher's method, techniques are still being developed to handle the case of dependent p-values.
• **Behrens–Fisher problem:** Yuri Linnik showed in 1966 that there is no uniformly most powerful test for the difference of two means when the variances are unknown and possibly unequal. That is, there is no exact test (meaning that, if the means are in fact equal, one that rejects the null hypothesis with probability exactly \( \alpha \)) that is also the most powerful for all values of the variances (which are thus nuisance parameters). Though there are many approximate solutions (such as Welch’s t-test), the problem continues to attract attention as one of the classic problems in statistics.

• **Multiple comparisons:** There are various ways to adjust p-values to compensate for the simultaneous or sequential testing of hypothesis. Of particular interest is how to simultaneously control the overall error rate, preserve statistical power, and incorporate the dependence between tests into the adjustment. These issues are especially relevant when the number of simultaneous tests can be very large, as is increasingly the case in the analysis of data from DNA microarrays.

• **Sampling of species problem:** How is a probability updated when there is unanticipated new data?

• **Doomsday argument:** How valid is the probabilistic argument that claims to predict the future lifetime of the human race given only an estimate of the total number of humans born so far?

• **Exchange paradox:** Issues arise within the subjectivistic interpretation of probability theory; more specifically within Bayesian decision theory. This is still an open problem among the subjectivists as no consensus has been reached yet. Examples include:

  *The two envelopes problem*
  *The necktie paradox*

• **Sunrise problem:** What is the probability that the sun will rise tomorrow? Very different answers arise depending on the methods used and assumptions made.

**Information Theory:**

• **Capacity of a network:** The capacity of a general wireless network is not known. There are some specific cases for which the capacity is known, such as the AWGN channel and fading channel.

• **Capacity of the broadcast channel:** The capacity of the broadcast channel, or the case in which a single transmitter is sending information to many receivers is unknown in general, though it is known for several specific cases.

• **Capacity of the interference channel (Two User):** The capacity of the interference channel, in the case where there are two transmitter and receiver pairs that interfere among each other, is unknown in general. Capacity is known in special cases: strong interference regime, injective-deterministic. Capacity is known in approximate sense or with in a gap for: injective-semi-deterministic, additive white Gaussian noise with per block power constraint.
• **Capacity of the two-way channel**: The capacity of the two-way channel (a channel in which information is sent in both directions simultaneously) is unknown.

• **The capacity of Aloha**: The ALOHAnet used a very simple access scheme for which the capacity is still unknown, though it is known in a few special cases.

• **Quantum capacity**: The capacity of a quantum channel is in general not known.

• **Distributed source coding**: The best way to compress multiple correlated information sources that do not communicate with each other is not known.

**Linguistics:**

• Is there a universal definition of *word*?

• Is there a universal definition of *sentence*?

• Are there any universal grammatical categories?

• Is syntactic structure constructed of part-whole relations of syntactic constituents or is it built of an asymmetrical dependency relation between words?

• Can the elements contained in words (morphemes) and the elements contained in sentences (words or syntactic constituents) be shown to follow the same principles of combination?

• How are domains for phonological processes related to syntactic structure? Do prosodic domains deviate from syntactic constituent structure?

• Is it possible to formally delineate languages from each other? That is to say, is it possible to use linguistic (rather than social) criteria to draw a clear boundary between two closely related languages with a dialect continuum between their respective standard forms (e.g. Occitan and Catalan)?

• How does grammaticalization function?

• What constitutes grammatical language, as viewed by native speakers of that particular language, i.e. the problem of gradient well-formedness?

• Is there one universal process with which the evolution of creole languages can be tracked?

• How does lexical substitution function given the potentially limitless number of different contexts, the limits of one's knowledge and the limits of one's understanding and usage of language?

• How do idiolects and dialects emerge? Are there any common patterns in their development? Can they be quantitatively and qualitatively measured at all and if so, how?

• How and when did language originate?

• How and when did different modes of language (spoken, signed, written) originate?

• *Were Homo sapiens* the first humans to use language? What about other species in the genus *Homo*?
- Is language continuous or discontinuous with earlier forms of communication? Did language appear suddenly or gradually?
- What language families are valid?
- Are any macro-families valid?
- Can any of the approximately 100 unclassified languages be classified? Or does our limited knowledge of them prevent that?
- Can we decipher any of the extant undeciphered writing systems?
- Language isolates have no demonstrated relatives, and essentially form language families on their own. Can any of the approximately 159 language isolates be shown to be related to other languages?
- Can we use the comparative method to reconstruct back to an arbitrary time depth, or do we need new methods to reconstruct the distant past of languages? Is there a time depth beyond which we cannot reconstruct?
- Can we ever demonstrate that all languages are ultimately related to each other, or that they aren't?
- Language emergence: Emergence of grammar
- Controversy: infant language acquisition / first language acquisition. How are infants able to learn language? One line of debate is between two points of view: that of psychological nativism, i.e., the language ability is somehow "hardwired" in the human brain, and that of the "tabula rasa" or blank slate, i.e., language is acquired due to brain's interaction with environment. Another formulation of this controversy is "nature versus nurture".
- Is the human ability to use syntax based on innate mental structures or is syntactic speech the function of intelligence and interaction with other humans? The question is closely related to those of language emergence and acquisition.
- The language acquisition device: How localized is language in the brain? Is there a particular area in the brain responsible for the development of language abilities or is it only partially localized?
- What fundamental reasons explain why ultimate attainment in second language acquisition is typically some way short of the native speaker's ability, with learners varying widely in performance?
- What are the optimal ways to achieve successful second-language acquisition?
- Animals and language: How much human language can animals be taught to use? How much of animal communication can be said to have the same properties as human language (e.g. compositionality of bird calls as syntax)?
- What role does linguistic intuition play, how is it formed and how does it function? Is it closely linked to exposure to a unique set of different experiences and their contexts throughout one's personal life?
How to deal with variation in language (including idiolects, dialects, sociolects, jargons, argots, etc.) to achieve effective and successful communication between individuals and between groups, i.e. what are the best ways to ensure efficient communication without misunderstandings: in everyday life and in educational, scientific and philosophical discussions?

What are the best ways to quantitatively and qualitatively compare linguistic competence and linguistic performance between individuals and between groups?

How does time (and the semantic change that it brings) and physical age influence linguistic competence?

How are argots formed, how do they function and what are the best ways to become proficient in an argot?

What causes linguistic features to begin to undergo language change at some points in time and in some dialects but not others?

Is there an objective gauge for the quality of translation?

What are the best strategies for quality translation: fidelity or transparency, dynamic or formal equivalence, etc.?

What are the best ways to deal with untranslatability, e.g. lexical gaps?

How to best deal with translation loss and its accumulation, e.g. when translating from a translation (see Chinese whispers)?

Can machine translations ever achieve the high degree of comprehensibility and quality of translations translated by a good professional human translator?

What are the effective ways to achieve proper localization and internationalization?

What makes a good dictionary?

To what extent are dictionaries reliable in terms of their supposed universality when spoken language is constantly changing (semantic change, semantic extension, semantic compression, etc.)?

What are good practices to avoid circular definitions in dictionaries? Is it possible to eliminate them at all, given the vagueness, polysemy, etc. in all languages?

What are the best ways to ensure efficient communication without misunderstandings: in everyday life and in educational, scientific and philosophical discussions? Is total terminology standardization attainable at all? If yes, does it involve the mass use of freely available and easily accessible terminology databases?

To what extent are termbases reliable and can their reliability be measured objectively? If yes, how and why? If no, why? What is the relationship between termbases and individual subjectivity and can subjectivity about word sense disambiguation be overcome at all or is it a natural result of different experiences in one's unique personal life?

How to successfully reduce lexicographic errors and lexicographic information costs?
• Is perfect computational word-sense disambiguation attainable by using software? If yes, how and why? If no, why? (This presupposes the solution to the unsolved problems in the other areas of linguistics as a basis.)
• Is accurate computational word-sense induction feasible? If yes, how and why? If not, why?
• Is there an objective way to determine which are the most difficult languages?
• To what extent are conlangs usable and useful as used as natural languages by humans?

List of Jewish economists

• Albert Aftalion, Bulgarian-born French economist
• George Akerlof, Nobel Prize (2001)
• Kenneth Arrow, Nobel Prize (1972)
• Robert Aumann, Nobel Prize (2005)
• Lord Bauer, economist
• Gary Becker, Nobel Prize (1992)
• Ben Bernanke, economist and former Chairman of the Federal Reserve
• Walter Block, Harold E. Wirth Endowed Chair in Economics at Loyola University in New Orleans
• Arthur Burns, economist and former Chairman of the Federal Reserve
• Otto Eckstein, a key developer of the idea of core inflation
• Richard Ehrenberg, economist
• Martin Feldstein, Harvard Professor; Chair of the Council of Economic Advisors in the Reagan Administration
• Robert Fogel, Nobel Prize (1993)
• Milton Friedman, Nobel Prize (1976)
• Barry Goldwater, half-Jewish American economist
• Charles Goodhart, Bank of England economist
• Alan Greenspan, economist and former Chairman of the Federal Reserve
• John Harsanyi, Nobel Prize (1994)
• Arnold Heertje, Dutch economist
• Rudolf Hilferding, Austrian-German marxist economist
• Leonid Hurwicz, Nobel Prize (2007)
• Richard Kahn, Baron Kahn, economist: multiplier
• Daniel Kahneman, Nobel Prize (2002)
• Leonid Kantorovich, Nobel Prize (1975)
• Henry Hazlitt, half-Jewish Austrian economist
• Israel Kirzner, economist (UK-born)
• Lawrence Klein, Nobel Prize (1980)
• János Kornai, economist
• Paul Krugman, Nobel Prize (2008)
• Simon Kuznets, Nobel Prize (1971)
• Vladimir Kvint, economist and strategist
• Ludwig Lachmann, economist
• Harold Laski, economist
• Emil Lederer, economist
• Wassily Leontief, Nobel Prize (1973)
• Abba P. Lerner, Russian-born British economist
• Leone Levi, political economist
• Robert Liefmann, economist
• Ephraim Lipson, economic historian
• Adolph Lowe, economist
• Rosa Luxemburg, economist, co-founder of the KPD
• Stephen Marglin, American economist
• Harry Markowitz, Nobel Prize (1990)
• Karl Marx, inventor of Marxist economics Kar Marx was ethnically Jewish. His maternal grandfather was a Dutch rabbi, while his paternal line had supplied Trier's rabbis since 1723, a role taken by his grandfather Meier Halevi Marx.
• Merton Miller, Nobel Prize (1990)
• Hyman Minsky, economist
• Noreena Hertz, economist and activist
• Ludwig von Mises, Austrian School economist
• Franco Modigliani, Nobel Prize (1985)
• Toby Moskowitz, financial economist
• Alexander Nove, economist
• Arthur Melvin Okun, chairman of the Council of Economic Advisers (1968-1969)
• Don Patinkin, Israeli economist
• Sigbert Prais, economist
• Karl Polanyi, Austrian-Hungarian economist and economic historian
• David Ricardo, economist (converted to Quakerism)
• Alvin E. Roth, Nobel prize (2012)
• Murray Rothbard, Austrian School economist, writer, libertarian, and father of anarcho-capitalism
• Nouriel Roubini, Iranian-American macroeconomist
• Paul Samuelson, Nobel Prize (1970)
• Arthur Seldon, economist
• Herbert A. Simon, Nobel Prize (1978)
• Sir Hans Singer, economist
• Robert Solow, Nobel Prize (1987)
• Gene Sperling, Director of the National Economic Council (2011-2014)
• Piero Sraffa, economist
• Herbert Stein, chairman of the Council of Economic Advisers (1971-1974)
• Joseph Stiglitz, Nobel Prize (2001)
• Lawrence Summers, economist, Treasury Secretary, and Harvard President
• Jacob Viner, Canadian economist
• Leo Wolman, economist.
• Basil Yamey, economist.
• Janet Yellen, economist, Chair of the US Federal Reserve Bank

**List of epidemics**

<table>
<thead>
<tr>
<th>Event</th>
<th>Date</th>
<th>Location</th>
<th>Disease</th>
<th>Death toll (estimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Influenza epidemic</td>
<td>1200 BC</td>
<td>Babylon, or Babirus of the Persians, Central</td>
<td>Sanskrit scholars found records of a disease resembling the Flu</td>
<td>Unknown</td>
</tr>
<tr>
<td>Event</td>
<td>Period</td>
<td>Location(s)</td>
<td>Pathogen/Cause</td>
<td>Casualties</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------</td>
<td>--------------------------------------------------</td>
<td>-----------------------------------------------------</td>
<td>-----------------------------------</td>
</tr>
<tr>
<td>Plague of Athens</td>
<td>429–426 BC</td>
<td>Greece, Libya, Egypt, Ethiopia</td>
<td>Unknown, possibly typhus, typhoid fever or viral hemorrhagic fever</td>
<td>75,000–100,000</td>
</tr>
<tr>
<td>412 BC epidemic</td>
<td>412 BC</td>
<td>Greece (Northern Greece, Roman Republic)</td>
<td>Unknown, possibly influenza</td>
<td>Unknown</td>
</tr>
<tr>
<td>Antonine Plague</td>
<td>165–180 (possibly up to 190)</td>
<td>Roman Empire</td>
<td>Unknown, possibly smallpox</td>
<td>5–10 million</td>
</tr>
<tr>
<td>Plague of Cyprian</td>
<td>250–266</td>
<td>Europe</td>
<td>Unknown, possibly smallpox</td>
<td>1 million+</td>
</tr>
<tr>
<td>Plague of Justinian</td>
<td>541–542</td>
<td>Europe and West Asia</td>
<td>Bubonic plague (beginning of First plague pandemic)</td>
<td>25–100 million (40–50% of population of Europe)</td>
</tr>
<tr>
<td>Roman Plague of 590</td>
<td>590</td>
<td>Rome, Byzantine Empire</td>
<td>Bubonic plague (part of First plague pandemic)</td>
<td>Unknown</td>
</tr>
<tr>
<td>Plague of Sheroe</td>
<td>627–628</td>
<td>Mesopotamia</td>
<td>Bubonic plague (part of First plague pandemic)</td>
<td>Unknown</td>
</tr>
<tr>
<td>Plague of 664</td>
<td>664–689</td>
<td>British Isles</td>
<td>Bubonic plague (part of First plague pandemic)</td>
<td>Unknown</td>
</tr>
<tr>
<td>Plague of 698–701</td>
<td>698–701</td>
<td>Byzantine Empire, West Asia, Syria, Mesopotamia</td>
<td>Bubonic plague (part of First plague pandemic)</td>
<td>Unknown</td>
</tr>
<tr>
<td>735–737 Japanese smallpox epidemic</td>
<td>735–737</td>
<td>Japan</td>
<td>Smallpox</td>
<td>2 million (approx. 1/3 of Japanese population)</td>
</tr>
<tr>
<td>Plague of 746–747</td>
<td>746–747</td>
<td>Byzantine Empire, West Asia, Africa</td>
<td>Bubonic plague (part of First plague pandemic)</td>
<td>Unknown</td>
</tr>
<tr>
<td>Black Death (start of the Second plague pandemic)</td>
<td>1346–1353</td>
<td>Europe, Asia and North Africa</td>
<td>Bubonic plague</td>
<td>75–200 million (10–60% of European population)</td>
</tr>
<tr>
<td>Sweating sickness (multiple)</td>
<td>1485–1551</td>
<td>Britain (England) and later continental Europe</td>
<td>Unknown, possibly an unknown species of hantavirus</td>
<td>10,000+</td>
</tr>
<tr>
<td>Outbreaks</td>
<td>Year</td>
<td>Region</td>
<td>Disease</td>
<td>Mortality</td>
</tr>
<tr>
<td>-----------</td>
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</tr>
<tr>
<td>1489 Spain typhus epidemic</td>
<td>1489</td>
<td>Spain</td>
<td>Typhus</td>
<td>17,000</td>
</tr>
<tr>
<td>1510 Influenza pandemic</td>
<td>1510</td>
<td>Asia, North Africa, Europe</td>
<td>Influenza</td>
<td>Unknown, around 1% of those infected</td>
</tr>
<tr>
<td>1520 Mexico smallpox epidemic</td>
<td>1519–1520</td>
<td>Mexico</td>
<td>Smallpox</td>
<td>5–8 million (40% of population)</td>
</tr>
<tr>
<td>Cocoliztli Epidemic of 1545–1548</td>
<td>1545–1548</td>
<td>Mexico</td>
<td>Possibly <em>Salmonella enterica</em></td>
<td>5–15 million (80% of population)</td>
</tr>
<tr>
<td>1561 Chile smallpox epidemic</td>
<td>1561–1562</td>
<td>Chile</td>
<td>Smallpox</td>
<td>Unknown (20-25% of native population)</td>
</tr>
<tr>
<td>1563 London plague</td>
<td>1563–1564</td>
<td>London, England</td>
<td>Bubonic plague</td>
<td>20,100+</td>
</tr>
<tr>
<td>Cocoliztli epidemic of 1576</td>
<td>1576–1580</td>
<td>Mexico</td>
<td>Possibly <em>Salmonella enterica</em></td>
<td>2–2.5 million (50% of population)</td>
</tr>
<tr>
<td>1582 Tenerife plague epidemic</td>
<td>1582–1583</td>
<td>Tenerife, Spain</td>
<td>Bubonic plague</td>
<td>5,000–9,000</td>
</tr>
<tr>
<td>1592–1596 Seneca nation measles epidemic</td>
<td>1592–1596</td>
<td>Seneca nation, United States and Canada</td>
<td>Measles</td>
<td>Unknown</td>
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<tr>
<td>1592–1593 Malta plague epidemic</td>
<td>1592–1593</td>
<td>Malta</td>
<td>Bubonic plague</td>
<td>3,000</td>
</tr>
<tr>
<td>1596–1602 Spain plague epidemic</td>
<td>1596–1602</td>
<td>Spain</td>
<td>Bubonic plague</td>
<td>600,000–700,000</td>
</tr>
<tr>
<td>1600–1650 South America</td>
<td>1600–1650</td>
<td>South America</td>
<td>Malaria</td>
<td>Unknown</td>
</tr>
<tr>
<td>Date</td>
<td>Location(s)</td>
<td>Disease(s)</td>
<td>Estimated Deaths</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>------------------------------------</td>
<td>------------------------------------------------</td>
<td>------------------</td>
<td></td>
</tr>
<tr>
<td>1603</td>
<td>London, England</td>
<td>Bubonic plague</td>
<td>40,000</td>
<td></td>
</tr>
<tr>
<td>1609</td>
<td>Egypt</td>
<td>Bubonic plague</td>
<td>1 million</td>
<td></td>
</tr>
<tr>
<td>1616–1620</td>
<td>Southern New England, United States, especially the Wampanoag people</td>
<td>Unknown, possibly leptospirosis with Weil syndrome. Classic explanations include yellow fever, bubonic plague, influenza, smallpox, chickenpox, typhus, and syndemic infection of hepatitis B and hepatitis D</td>
<td>Unknown (estimated 30–90% of population)</td>
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<tr>
<td>1629–1631</td>
<td>Italy</td>
<td>Bubonic plague</td>
<td>280,000</td>
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<tr>
<td>1632–1635</td>
<td>Augsburg, Germany</td>
<td>Bubonic plague</td>
<td>13,712</td>
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<tr>
<td>1633–1634</td>
<td>Massachusetts Bay Colony, United States</td>
<td>Smallpox</td>
<td>1,000</td>
<td></td>
</tr>
<tr>
<td>1634–1640</td>
<td>Wyandot people, United States and Canada</td>
<td>Smallpox and Influenza</td>
<td>15,000–25,000</td>
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<tr>
<td>1636–1637</td>
<td>London and Westminster, England</td>
<td>Bubonic plague</td>
<td>10,400</td>
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<tr>
<td>1641–1644</td>
<td>China</td>
<td>Bubonic plague</td>
<td>Unknown</td>
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<tr>
<td>1647–1652</td>
<td>Spain</td>
<td>Bubonic plague</td>
<td>500,000</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Location</td>
<td>Disease</td>
<td>Deaths or Cases</td>
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</tr>
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<td>------------</td>
<td>---------------------------</td>
<td>------------------</td>
<td>-----------------</td>
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<tr>
<td>1648</td>
<td>Central America</td>
<td>Yellow fever</td>
<td>Unknown</td>
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</tr>
<tr>
<td>1648</td>
<td>Central America</td>
<td>Yellow fever</td>
<td>Unknown</td>
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<tr>
<td>1656</td>
<td>Italy</td>
<td>Bubonic plague</td>
<td>1,250,000</td>
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<tr>
<td>1663–1664</td>
<td>Amsterdam, Netherlands</td>
<td>Bubonic plague</td>
<td>24,148</td>
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<tr>
<td>1665–1666</td>
<td>England</td>
<td>Bubonic plague</td>
<td>100,000</td>
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<tr>
<td>1668</td>
<td>France</td>
<td>Bubonic plague</td>
<td>40,000</td>
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<tr>
<td>1675–1676</td>
<td>Malta</td>
<td>Bubonic plague</td>
<td>11,300</td>
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<tr>
<td>1676–1685</td>
<td>Spain</td>
<td>Bubonic plague</td>
<td>Unknown</td>
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<tr>
<td>1677–1678</td>
<td>Massachusetts Bay Colony, United States</td>
<td>Smallpox</td>
<td>750–1000</td>
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<tr>
<td>1679</td>
<td>Vienna, Austria</td>
<td>Bubonic plague</td>
<td>76,000</td>
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<tr>
<td>1681</td>
<td>Prague, Czech Republic</td>
<td>Bubonic plague</td>
<td>83,000</td>
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<tr>
<td>1687</td>
<td>South Africa</td>
<td>Unknown, possibly Influenza</td>
<td>Unknown</td>
<td></td>
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<tr>
<td>1693</td>
<td>Boston, United States</td>
<td>Yellow fever</td>
<td>3,100+</td>
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</tr>
<tr>
<td>1699</td>
<td>Charleston and Philadelphia, United States</td>
<td>Yellow fever</td>
<td>520 (300 in Charleston, 220 in Philadelphia)</td>
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</tr>
<tr>
<td>Year Range</td>
<td>Location</td>
<td>Disease</td>
<td>Cases (Noted)</td>
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<td>------------------</td>
<td>---------------------------------------------------------------------------</td>
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<tr>
<td>1702</td>
<td>New York City, United States</td>
<td>Yellow fever</td>
<td>500</td>
<td></td>
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<tr>
<td>1702–1703</td>
<td>New France, Canada</td>
<td>Smallpox</td>
<td>1,300</td>
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<tr>
<td>1707–1709</td>
<td>Iceland</td>
<td>Smallpox</td>
<td>18,000+ (36% of population)</td>
<td></td>
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<tr>
<td>1710–1712</td>
<td>Denmark, Sweden, Lithuania</td>
<td>Bubonic plague</td>
<td>164,000</td>
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<tr>
<td>1713–1715</td>
<td>Thirteen Colonies and New France, Canada</td>
<td>Measles</td>
<td>Unknown</td>
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</tr>
<tr>
<td>1720–1722</td>
<td>France</td>
<td>Bubonic plague</td>
<td>100,000+</td>
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<tr>
<td>1721</td>
<td>Massachusetts Bay Colony</td>
<td>Smallpox</td>
<td>844</td>
<td></td>
</tr>
<tr>
<td>1730</td>
<td>Cádiz, Spain</td>
<td>Yellow fever</td>
<td>2,200</td>
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<tr>
<td>1732–1733</td>
<td>Thirteen Colonies</td>
<td>Influenza</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>1733</td>
<td>New France, Canada</td>
<td>Smallpox</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>Year Range</td>
<td>Location</td>
<td>Disease</td>
<td>Mortality</td>
<td></td>
</tr>
<tr>
<td>------------</td>
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<tr>
<td>1735–1741</td>
<td>New England, New York, New Jersey, United States</td>
<td>Diphtheria</td>
<td>20,000</td>
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<tr>
<td>1738</td>
<td>Balkans</td>
<td>Bubonic plague</td>
<td>50,000</td>
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<tr>
<td>1738–1739</td>
<td>North Carolina, United States</td>
<td>Smallpox</td>
<td>7,700–11,700</td>
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<tr>
<td>1739–1740</td>
<td>Thirteen Colonies</td>
<td>Measles</td>
<td>Unknown</td>
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<tr>
<td>1741</td>
<td>Cartagena, Colombia</td>
<td>Yellow fever</td>
<td>20,000</td>
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<tr>
<td>1743</td>
<td>Messina, Sicily, Italy</td>
<td>Bubonic plague</td>
<td>40,000–50,000</td>
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<tr>
<td>1747</td>
<td>Thirteen Colonies</td>
<td>Measles</td>
<td>Unknown</td>
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<tr>
<td>1759</td>
<td>North America</td>
<td>Measles</td>
<td>Unknown</td>
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<tr>
<td>1760</td>
<td>Charleston, United States</td>
<td>Smallpox</td>
<td>730–940</td>
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<tr>
<td>1761</td>
<td>North America, West Indies</td>
<td>Influenza</td>
<td>Unknown</td>
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</tr>
<tr>
<td>Year</td>
<td>Location</td>
<td>Disease</td>
<td>Estimated Deaths</td>
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<td>--------</td>
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<td>--------------</td>
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<tr>
<td>1762</td>
<td>Havana, Cuba</td>
<td>Yellow fever</td>
<td>8,000</td>
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<tr>
<td>1763</td>
<td>North America, present-day</td>
<td>Smallpox</td>
<td>Unknown</td>
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<tr>
<td>1770–1772</td>
<td>Russia</td>
<td>Bubonic plague</td>
<td>50,000</td>
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<tr>
<td>1772</td>
<td>North America</td>
<td>Measles</td>
<td>Unknown</td>
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<tr>
<td>1772–1773</td>
<td>Persia</td>
<td>Bubonic plague</td>
<td>2 million+</td>
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<tr>
<td>1775–1776</td>
<td>England</td>
<td>Influenza</td>
<td>Unknown</td>
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<tr>
<td>1775–1782</td>
<td>Pacific Northwest, United States</td>
<td>Smallpox</td>
<td>11,000+</td>
<td></td>
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<tr>
<td>1778</td>
<td>Spain</td>
<td>Dengue fever</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>1788</td>
<td>Pueblo Indians, Southwestern United States</td>
<td>Smallpox</td>
<td>Unknown</td>
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<tr>
<td>1788</td>
<td>United States</td>
<td>Measles</td>
<td>Unknown</td>
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<tr>
<td>1789–1790</td>
<td>New South Wales, Australia</td>
<td>Smallpox</td>
<td>Unknown (50–70% of native)</td>
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<tr>
<td>Disease</td>
<td>Year(s)</td>
<td>Location</td>
<td>Disease Type</td>
<td>Population</td>
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<td>------------------------------</td>
<td>---------------</td>
<td>----------------------</td>
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<tr>
<td>Smallpox epidemic</td>
<td>1793</td>
<td>United States</td>
<td>Influenza and epidemic typhus</td>
<td>Unknown</td>
</tr>
<tr>
<td>1793 United States influenza and typhus epidemic</td>
<td>1793</td>
<td>Philadelphia, United States</td>
<td>Yellow fever</td>
<td>5,000+</td>
</tr>
<tr>
<td>1800–1803 Spain yellow fever epidemic</td>
<td>1800–1803</td>
<td>Spain</td>
<td>Yellow fever</td>
<td>60,000+</td>
</tr>
<tr>
<td>1801 Ottoman Empire and Egypt bubonic plague epidemic</td>
<td>1801</td>
<td>Ottoman Empire, Egypt</td>
<td>Bubonic plague</td>
<td>Unknown</td>
</tr>
<tr>
<td>1802–1803 Saint-Domingue yellow fever epidemic</td>
<td>1802–1803</td>
<td>Saint-Domingue</td>
<td>Yellow fever</td>
<td>29,000–55,000</td>
</tr>
<tr>
<td>1812 Egypt bubonic plague epidemic</td>
<td>1812</td>
<td>Egypt</td>
<td>Bubonic plague</td>
<td>Unknown</td>
</tr>
<tr>
<td>1812 Russia Typhus epidemic</td>
<td>1812</td>
<td>Russia</td>
<td>Typhus</td>
<td>300,000</td>
</tr>
<tr>
<td>1812–19 Ottoman plague epidemic</td>
<td>1812–1819</td>
<td>Ottoman Empire</td>
<td>Bubonic plague</td>
<td>300,000+</td>
</tr>
<tr>
<td>1813–14 Malta plague</td>
<td>1813–1814</td>
<td>Malta</td>
<td>Bubonic plague</td>
<td>4,500</td>
</tr>
<tr>
<td>Year(s)</td>
<td>Location(s)</td>
<td>Disease(s)</td>
<td>Death Count</td>
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</tr>
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<td>------------------</td>
<td>--------------------------------------------------</td>
<td>-----------------------------</td>
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<td></td>
</tr>
<tr>
<td>Caragea's plague</td>
<td>Romania</td>
<td>Bubonic plague</td>
<td>60,000</td>
<td></td>
</tr>
<tr>
<td>1817–1819</td>
<td>Ireland</td>
<td>Typhus</td>
<td>65,000</td>
<td></td>
</tr>
<tr>
<td>First cholera pandemic</td>
<td>1817–1824</td>
<td>Asia, Europe</td>
<td>Cholera</td>
<td>100,000+</td>
</tr>
<tr>
<td>1820</td>
<td>Savannah, Georgia, United States</td>
<td>Yellow fever</td>
<td>700</td>
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</tr>
<tr>
<td>1821</td>
<td>Barcelona, Spain</td>
<td>Yellow fever</td>
<td>5,000–20,000</td>
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</tr>
<tr>
<td>Second cholera pandemic</td>
<td>1826–1837</td>
<td>Asia, Europe, North America</td>
<td>Cholera</td>
<td>100,000+</td>
</tr>
<tr>
<td>1828–1829</td>
<td>New South Wales, Australia</td>
<td>Smallpox</td>
<td>19,000</td>
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</tr>
<tr>
<td>Groningen epidemic</td>
<td>1829</td>
<td>Malaria</td>
<td>2,800</td>
<td></td>
</tr>
<tr>
<td>1829–1833</td>
<td>Pacific Northwest, United States</td>
<td>Malaria, possibly other diseases too</td>
<td>150,000</td>
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</tr>
<tr>
<td>1829–1835</td>
<td>Iran</td>
<td>Bubonic plague</td>
<td>Unknown</td>
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<tr>
<td>1831–1834</td>
<td>Plains Indians</td>
<td>Smallpox</td>
<td>Unknown</td>
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<td>1834–1836</td>
<td>Egypt</td>
<td>Bubonic plague</td>
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<tr>
<td>Year Range</td>
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<td>1836</td>
<td>Egypt</td>
<td>Plague</td>
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<tr>
<td>1837–1838</td>
<td>Great Plains, United States and Canada</td>
<td>Smallpox</td>
<td>17,000+</td>
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<td>1840</td>
<td>South Africa</td>
<td>Smallpox</td>
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<td>1841</td>
<td>Southern United States (especially Louisiana and Florida)</td>
<td>Yellow fever</td>
<td>3,498</td>
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<tr>
<td>1847–1848</td>
<td>Canada</td>
<td>Typhus</td>
<td>20,000+</td>
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<td>1847</td>
<td>Southern United States (especially New Orleans)</td>
<td>Yellow fever</td>
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<td>1847–1848</td>
<td>Worldwide</td>
<td>Influenza</td>
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<td>1848–1849</td>
<td>Hawaiian Kingdom</td>
<td>Measles, whooping cough, dysentery and influenza</td>
<td>10,000</td>
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<tr>
<td>1850–1851</td>
<td>North America</td>
<td>Influenza</td>
<td>Unknown</td>
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<td>1853</td>
<td>New Orleans, United States</td>
<td>Yellow fever</td>
<td>7,970</td>
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<td>Event Description</td>
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<td>Location</td>
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<tr>
<td>Third cholera pandemic</td>
<td>1846–1860</td>
<td>Russia</td>
<td>Cholera</td>
<td>1 million+</td>
</tr>
<tr>
<td>1853 Ottoman Empire plague epidemic</td>
<td>1853</td>
<td>Ottoman Empire</td>
<td>Bubonic plague</td>
<td>Unknown</td>
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<tr>
<td>1853 Copenhagen cholera outbreak</td>
<td>1853</td>
<td>Copenhagen, Denmark</td>
<td>Cholera</td>
<td>4,737</td>
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<td>1854 Broad Street cholera outbreak</td>
<td>1854</td>
<td>London, England</td>
<td>Cholera</td>
<td>616</td>
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<tr>
<td>1855 Norfolk yellow fever epidemic</td>
<td>1855</td>
<td>Norfolk and Portsmouth, England</td>
<td>Yellow fever</td>
<td>3,000 (2,000 in Norfolk, 1,000 in Portsmouth)</td>
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<tr>
<td>Third plague pandemic</td>
<td>1855–1960</td>
<td>Worldwide</td>
<td>Bubonic plague</td>
<td>12 million+ in India and China alone</td>
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<tr>
<td>1857 Lisbon yellow fever epidemic</td>
<td>1857</td>
<td>Lisbon, Portugal</td>
<td>Yellow fever</td>
<td>6,000</td>
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<td>1857 Victoria smallpox epidemic</td>
<td>1857</td>
<td>Victoria, Australia</td>
<td>Smallpox</td>
<td>Unknown</td>
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<td>1857–1859 Europe and the Americas influenza epidemic</td>
<td>1857–1859</td>
<td>Europe, North America, South America</td>
<td>Influenza</td>
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<td>1862–1863 British Columbia Smallpox epidemic</td>
<td>1862–1863</td>
<td>British Columbia, Canada</td>
<td>Smallpox</td>
<td>32,000</td>
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<td>1861–1865 United States</td>
<td>1861–1865</td>
<td>United States</td>
<td>Typhoid fever</td>
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<tr>
<td>Typhoid fever</td>
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<td></td>
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<tr>
<td>Fourth cholera pandemic</td>
<td>1863–1875</td>
<td>Middle East</td>
<td>Cholera</td>
<td>600,000</td>
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<tr>
<td>1867 Sydney measles</td>
<td>1867</td>
<td>Sydney, Australia</td>
<td>Measles</td>
<td>748</td>
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<tr>
<td>1871 Buenos Aires yellow fever</td>
<td>1871</td>
<td>Buenos Aires, Argentina</td>
<td>Yellow fever</td>
<td>13,500–26,200</td>
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<td>1870–1875 Europe smallpox</td>
<td>1870–1875</td>
<td>Europe</td>
<td>Smallpox</td>
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<td>1875 Fiji measles</td>
<td>1875</td>
<td>Fiji</td>
<td>Measles</td>
<td>40,000</td>
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<td>1875–1876 Australia scarlet fever</td>
<td>1875–1876</td>
<td>Australia</td>
<td>Scarlet fever</td>
<td>8,000</td>
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<td>1876 Ottoman Empire plague</td>
<td>1876</td>
<td>Ottoman Empire</td>
<td>Bubonic plague</td>
<td>20,000</td>
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<td>1878 New Orleans yellow fever</td>
<td>1878</td>
<td>New Orleans, United States</td>
<td>Yellow fever</td>
<td>4,046</td>
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<td>1878 Mississippi Valley yellow fever</td>
<td>1878</td>
<td>Mississippi Valley, United States</td>
<td>Yellow fever</td>
<td>13,000</td>
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<tr>
<td>Fifth cholera pandemic</td>
<td>1881–1896</td>
<td>Asia, Africa, Europe, South America</td>
<td>Cholera</td>
<td>298,600</td>
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<tr>
<td>1885</td>
<td>1885</td>
<td>Montreal, Canada</td>
<td>Smallpox</td>
<td>3,164</td>
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<td>Event</td>
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<td>Location(s)</td>
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<tr>
<td>Montreal smallpox epidemic</td>
<td>1889–1890</td>
<td>Worldwide</td>
<td>Influenza</td>
<td>1 million</td>
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<td>Bombay plague epidemic</td>
<td>1896–1905</td>
<td>Bombay, India</td>
<td>Bubonic plague</td>
<td>20,788</td>
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<tr>
<td>1899 Porto plague outbreak</td>
<td>1899</td>
<td>Porto, Portugal</td>
<td>Bubonic plague</td>
<td>132</td>
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<td>Sixth cholera pandemic</td>
<td>1899–1923</td>
<td>Europe, Asia, Africa</td>
<td>Cholera</td>
<td>800,000+</td>
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<td>San Francisco plague of 1900–1904</td>
<td>1900–1904</td>
<td>San Francisco, United States</td>
<td>Bubonic plague</td>
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<td>1900–1920 Uganda African trypanosomiasis epidemic</td>
<td>1900–1920</td>
<td>Uganda</td>
<td>African trypanosomiasis</td>
<td>200,000–300,000</td>
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<td>1903 India plague epidemic</td>
<td>1903</td>
<td>India</td>
<td>Bubonic Plague</td>
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<td>1903 Fremantle plague epidemic</td>
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<td>Fremantle</td>
<td>Bubonic plague</td>
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<td>Manchurian plague</td>
<td>1910–1911</td>
<td>China</td>
<td>Pneumonic plague</td>
<td>60,000</td>
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<td>1910 China plague</td>
<td>1910–1912</td>
<td>China</td>
<td>Bubonic plague</td>
<td>40,000</td>
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<tr>
<td>1915 Encephalitis lethargica</td>
<td>1915–1926</td>
<td>Worldwide</td>
<td>Encephalitis lethargica</td>
<td>1.5 million</td>
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<tr>
<td>Year(s)</td>
<td>Location</td>
<td>Disease</td>
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<td>-------------------------</td>
<td>----------------------------------</td>
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<td>1916</td>
<td>United States</td>
<td>Poliomyelitis</td>
<td>7,130</td>
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<tr>
<td>1916–1920</td>
<td>Worldwide</td>
<td>Influenza A virus subtype H1N1</td>
<td>17–100 million</td>
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<tr>
<td>1918–1922</td>
<td>Russia</td>
<td>Typhus</td>
<td>2.5 million</td>
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<td>1924</td>
<td>Los Angeles, United States</td>
<td>Pneumonic plague</td>
<td>30</td>
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<tr>
<td>1924–1925</td>
<td>Minnesota, United States</td>
<td>Smallpox</td>
<td>500</td>
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<tr>
<td>1927</td>
<td>Montreal, Canada</td>
<td>Typhoid fever</td>
<td>538</td>
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<tr>
<td>1929–1930</td>
<td>Worldwide</td>
<td>Psittacosis</td>
<td>100+</td>
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<tr>
<td>1937</td>
<td>Croydon, United Kingdom</td>
<td>Typhoid fever</td>
<td>43</td>
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<td>1940</td>
<td>Sudan</td>
<td>Yellow fever</td>
<td>1,627</td>
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<td>1942–1944</td>
<td>Egypt</td>
<td>Malaria</td>
<td>Unknown</td>
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<tr>
<td>1946</td>
<td>China</td>
<td>Bubonic plague</td>
<td>Unknown</td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Location</td>
<td>Disease</td>
<td>Number</td>
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</tr>
<tr>
<td>------------</td>
<td>----------------</td>
<td>----------------------------</td>
<td>--------</td>
<td></td>
</tr>
<tr>
<td>1946</td>
<td>Egypt</td>
<td>Relapsing fever epidemic</td>
<td>Unknown</td>
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<tr>
<td>1947</td>
<td>Egypt</td>
<td>Cholera</td>
<td>10,277</td>
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<td>1948–1952</td>
<td>United States</td>
<td>Poliomyelitis</td>
<td>9,000</td>
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<td>1957–1958</td>
<td>Worldwide</td>
<td>Influenza A virus subtype H2N2</td>
<td>1–4 million</td>
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<tr>
<td>1960–1962</td>
<td>Ethiopia</td>
<td>Yellow fever</td>
<td>30,000</td>
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<tr>
<td></td>
<td>Worldwide</td>
<td>Cholera (El Tor strain)</td>
<td>Unknown</td>
<td></td>
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<tr>
<td>1961–1975</td>
<td>Worldwide</td>
<td>Cholera (El Tor strain)</td>
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<tr>
<td>1968–1970</td>
<td>Worldwide</td>
<td>Influenza A virus subtype H3N2</td>
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<td>1971</td>
<td>Staphorst, Netherlands</td>
<td>Poliomyelitis</td>
<td>5</td>
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<td>1972</td>
<td>Yugoslavia</td>
<td>Smallpox</td>
<td>35</td>
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<td>1972–1973</td>
<td>United States</td>
<td>Influenza A virus subtype H3N2</td>
<td>1,027</td>
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<td>1973</td>
<td>Italy</td>
<td>Cholera (El Tor strain)</td>
<td>24</td>
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<td>1974</td>
<td>India</td>
<td>Smallpox</td>
<td>15,000</td>
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<tr>
<td>India</td>
<td>1981–present</td>
<td>Worldwide</td>
<td>HIV/AIDS</td>
<td>32 million+ (23.6–43.8 million)</td>
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<tr>
<td>1984 Western Sahara plague</td>
<td>1984</td>
<td>Western Sahara</td>
<td>Bubonic plague</td>
<td>64</td>
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<tr>
<td>1986 Oju yellow fever epidemic</td>
<td>1986</td>
<td>Oju, Nigeria</td>
<td>Yellow fever</td>
<td>5,600+</td>
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<td>1987 Mali yellow fever epidemic</td>
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<td>Mali</td>
<td>Yellow fever</td>
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<td>1991 Bangladesh cholera epidemic</td>
<td>1991</td>
<td>Bangladesh</td>
<td>Cholera</td>
<td>8,410–9,432</td>
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<td>1994 plague in India</td>
<td>1994</td>
<td>India</td>
<td>Bubonic plague and Pneumonic plague</td>
<td>56</td>
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<tr>
<td>United Kingdom BSE outbreak</td>
<td>1996–2001</td>
<td>United Kingdom</td>
<td>vCJD</td>
<td>178</td>
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<tr>
<td>1996 West Africa meningitis epidemic</td>
<td>1996</td>
<td>West Africa</td>
<td>Meningitis</td>
<td>10,000</td>
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<tr>
<td>2000 Central America dengue epidemic</td>
<td>2000</td>
<td>Central America</td>
<td>Dengue fever</td>
<td>40+</td>
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<td>2001 Nigeria cholera epidemic</td>
<td>2001</td>
<td>Nigeria</td>
<td>Cholera</td>
<td>400+</td>
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<td>2001 South</td>
<td>2001</td>
<td>South Africa</td>
<td>Cholera</td>
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<td>Disease</td>
<td>Year(s)</td>
<td>Region(s)</td>
<td>Cause</td>
<td>Number</td>
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<td>Africa cholera epidemic</td>
<td>2002–04</td>
<td>Worldwide</td>
<td>Severe acute respiratory syndrome (SARS)</td>
<td>774</td>
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<td>2003 Algeria plague outbreak</td>
<td>2003</td>
<td>Algeria</td>
<td>Bubonic plague</td>
<td>1 (18 cases)</td>
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<td>Avian influenza outbreaks in the 2000s</td>
<td>2003–19</td>
<td>Southeast Asia and Egypt</td>
<td>Influenza A virus subtype H5N1</td>
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<td>2004 Afghanistan leishmaniasis epidemic</td>
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<td>Afghanistan</td>
<td>Leishmaniasis</td>
<td>0 (3,958 cases)</td>
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<td>2004 Indonesia dengue epidemic</td>
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<td>Dengue fever</td>
<td>658</td>
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<td>2004 Senegal cholera outbreak</td>
<td>2004</td>
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<td>Cholera</td>
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<td>2004 Sudan ebola outbreak</td>
<td>2004</td>
<td>Sudan</td>
<td>Ebola</td>
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<td>2005 dengue outbreak in Singapore</td>
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<td>Dengue fever</td>
<td>27</td>
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<td>2006 Luanda cholera epidemic</td>
<td>2006</td>
<td>Luanda, Angola</td>
<td>Cholera</td>
<td>1,200+</td>
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<td>2006 Ituri Province plague epidemic</td>
<td>2006</td>
<td>Ituri Province, Democratic Republic of the Congo</td>
<td>Bubonic plague</td>
<td>61</td>
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<td>2006 India malaria outbreak</td>
<td>2006</td>
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<td>Malaria</td>
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<td>2006 dengue</td>
<td>2006</td>
<td>India</td>
<td>Dengue fever</td>
<td>50+</td>
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<tr>
<td>Outbreak in India</td>
<td>Year</td>
<td>Location</td>
<td>Disease</td>
<td>Cases</td>
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<td>Chikungunya virus</td>
<td>2006</td>
<td>India</td>
<td>Chikungunya virus</td>
<td>Unknown (numerous widespread cases)</td>
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<td>2006 dengue outbreak in Pakistan</td>
<td>2006</td>
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<td>Dengue fever</td>
<td>50+</td>
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<tr>
<td>2006 Philippines dengue epidemic</td>
<td>2006</td>
<td>Philippines</td>
<td>Dengue fever</td>
<td>1,000</td>
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<tr>
<td>2006–07 East Africa Rift Valley fever outbreak</td>
<td>2006–2007</td>
<td>East Africa</td>
<td>Rift Valley fever</td>
<td>394</td>
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<td>Mweka ebola epidemic</td>
<td>2007</td>
<td>Democratic Republic of the Congo</td>
<td>Ebola</td>
<td>187</td>
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<td>2007 Ethiopia cholera epidemic</td>
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<td>Ethiopia</td>
<td>Cholera</td>
<td>684</td>
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<td>2007 Iraq cholera outbreak</td>
<td>2007</td>
<td>Iraq</td>
<td>Cholera</td>
<td>10</td>
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<td>2007 Nigeria polio outbreak</td>
<td>2007</td>
<td>Nigeria</td>
<td>Poliomyelitis</td>
<td>Unknown (69 cases)</td>
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<td>2007 Puerto Rico, Dominican Republic, and Mexico dengue fever epidemic</td>
<td>2007</td>
<td>Puerto Rico, Dominican Republic, Mexico</td>
<td>Dengue fever</td>
<td>183</td>
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<td>2007 Uganda ebola outbreak</td>
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<td>Uganda</td>
<td>Ebola</td>
<td>37</td>
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<tr>
<td>2007 Vietnam</td>
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<td>Country/Region</td>
<td>Disease Type</td>
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<td>Cholera</td>
<td>2008</td>
<td>Brazil</td>
<td>Dengue fever</td>
<td>67</td>
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<td>cholera outbreak</td>
<td>2008</td>
<td>Cambodia</td>
<td>Dengue fever</td>
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<td>Chad</td>
<td>Cholera</td>
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<td>China</td>
<td>Hand, foot, and mouth disease</td>
<td>3,322+</td>
</tr>
<tr>
<td>cholera</td>
<td>2008</td>
<td>India</td>
<td>Cholera</td>
<td>115</td>
</tr>
<tr>
<td>cholera</td>
<td>2008</td>
<td>Madagascar</td>
<td>Bubonic plague</td>
<td>18+</td>
</tr>
<tr>
<td>cholera</td>
<td>2008</td>
<td>Philippines</td>
<td>Dengue fever</td>
<td>172</td>
</tr>
<tr>
<td>cholera</td>
<td>2008–09</td>
<td>Zimbabwe</td>
<td>Cholera</td>
<td>4,293</td>
</tr>
<tr>
<td>cholera outbreak</td>
<td>2009</td>
<td>Bolivia</td>
<td>Dengue fever</td>
<td>18</td>
</tr>
<tr>
<td>cholera</td>
<td>2009</td>
<td>India</td>
<td>Hepatitis B</td>
<td>49</td>
</tr>
<tr>
<td>cholera</td>
<td>2009</td>
<td>Queensland</td>
<td>Dengue fever</td>
<td>1+ (503)</td>
</tr>
<tr>
<td>Year</td>
<td>Disease/Outbreak</td>
<td>Location</td>
<td>Description</td>
<td>Cases</td>
</tr>
<tr>
<td>------</td>
<td>------------------</td>
<td>----------</td>
<td>-------------</td>
<td>-------</td>
</tr>
<tr>
<td>2009</td>
<td>Dengue outbreak</td>
<td>Worldwide</td>
<td>Mumps</td>
<td>Unknown</td>
</tr>
<tr>
<td>2009-10</td>
<td>West African meningitis outbreak</td>
<td>West Africa</td>
<td>Meningitis</td>
<td>1,100</td>
</tr>
<tr>
<td>2009-2010</td>
<td>Swine flu pandemic</td>
<td>Worldwide</td>
<td>Influenza A virus subtype H1N1</td>
<td>284,000 (possible range 151,700-575,400)</td>
</tr>
<tr>
<td>2010-2019</td>
<td>Haitian cholera outbreak</td>
<td>Haiti</td>
<td>Cholera (strain serogroup O1, serotype Ogawa)</td>
<td>10,075</td>
</tr>
<tr>
<td>2010-2014</td>
<td>Democratic Republic of the Congo measles outbreak</td>
<td>Democratic Republic of the Congo</td>
<td>Measles</td>
<td>4,500+</td>
</tr>
<tr>
<td>2011</td>
<td>Vietnam hand, foot and mouth disease epidemic</td>
<td>Vietnam</td>
<td>Hand, foot and mouth disease</td>
<td>170</td>
</tr>
<tr>
<td>2011</td>
<td>Dengue outbreak in Pakistan</td>
<td>Pakistan</td>
<td>Dengue fever</td>
<td>350+</td>
</tr>
<tr>
<td>2012</td>
<td>Yellow fever outbreak in Darfur, Sudan</td>
<td>Darfur, Sudan</td>
<td>Yellow fever</td>
<td>171</td>
</tr>
<tr>
<td>2012-2020</td>
<td>Middle East respiratory syndrome</td>
<td>Worldwide</td>
<td>Middle East respiratory syndrome / MERS-CoV</td>
<td>862 (as of 13 January 2020)</td>
</tr>
<tr>
<td>Date</td>
<td>Location</td>
<td>Disease</td>
<td>Cases</td>
<td></td>
</tr>
<tr>
<td>------------</td>
<td>---------------------------</td>
<td>--------------------------------------------</td>
<td>----------------</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>Singapore</td>
<td>Dengue fever</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>2013</td>
<td>Vietnam</td>
<td>Measles</td>
<td>142</td>
<td></td>
</tr>
<tr>
<td>2013–2016</td>
<td>Worldwide, primarily</td>
<td>Ebola virus disease</td>
<td>11,323+</td>
<td></td>
</tr>
<tr>
<td></td>
<td>concentrated in Guinea,</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Liberia, Sierra Leone</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2013–2015</td>
<td>Americas</td>
<td>Chikungunya</td>
<td>183</td>
<td></td>
</tr>
<tr>
<td>2013–2019</td>
<td>China</td>
<td>Influenza A virus subtype H7N9</td>
<td>616</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>Madagascar</td>
<td>Bubonic plague</td>
<td>292</td>
<td></td>
</tr>
<tr>
<td>2014</td>
<td>India</td>
<td>Primarily Hepatitis E, but also Hepatitis A</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>2015</td>
<td>India</td>
<td>Influenza A virus subtype H1N1</td>
<td>2,035</td>
<td></td>
</tr>
<tr>
<td>2015–2016</td>
<td>Worldwide</td>
<td>Zika virus</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>2016</td>
<td>Angola and DR Congo</td>
<td>Yellow fever</td>
<td>498 (377 in</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Angola, 121</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>in Congo)</td>
<td></td>
</tr>
<tr>
<td>2016–20</td>
<td>Yemen</td>
<td>Cholera</td>
<td>3,886 (as of</td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Year</td>
<td>Disease</td>
<td>Cases</td>
<td></td>
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<td>-----------------------------------</td>
<td>---------</td>
<td></td>
</tr>
<tr>
<td>Yemen</td>
<td>Present</td>
<td>Cholera outbreak</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2017 dengue outbreak in Peshawar</td>
<td>2017</td>
<td>Peshawar, Pakistan Dengue fever</td>
<td>69</td>
<td></td>
</tr>
<tr>
<td>2017 Gorakhpur Japanese encephalitis outbreak</td>
<td>2017</td>
<td>India Japanese encephalitis</td>
<td>1,317</td>
<td></td>
</tr>
<tr>
<td>2017–18 United States flu season</td>
<td>2017–2018</td>
<td>United States Seasonal influenza</td>
<td>61,000 (46,000–95,000)</td>
<td></td>
</tr>
<tr>
<td>2018 Nipah virus outbreak in Kerala</td>
<td>2018</td>
<td>India Nipah virus infection</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>2019 measles outbreak in the Democratic Republic of the Congo</td>
<td>2019–present</td>
<td>Democratic Republic of the Congo Measles</td>
<td>6,400+ (as of April 2020)</td>
<td></td>
</tr>
<tr>
<td>2019 Philippines measles outbreak</td>
<td>2019–present</td>
<td>Philippines Measles</td>
<td>415</td>
<td></td>
</tr>
<tr>
<td>2019 Kuala Koh measles outbreak</td>
<td>2019</td>
<td>Kuala Koh, Malaysia Measles</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2019 Samoa measles outbreak</td>
<td>2019–present</td>
<td>Samoa Measles</td>
<td>83</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
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</tr>
</tbody>
</table>

"We think that history is created in the big things, in the big events, but history is also created in the small things that we do every day, in the personal choices we make—to think or not to think, to hold our tongues or to speak up, to act or not to act. Our actions have a ripple effect on those around us. Every time we conform or don't, we're shaping the world into our vision or someone else's vision. The universe isn't made up of atoms it's made up of stories, and these stories are shaped in college campuses and coffee houses around the country, not just in boardrooms and government buildings."

— Sharanya Haridas
100 most influential people in the world

- Muhammad (570 – 632 AD) Prophet of Islam.
- Isaac Newton (1642 – 1727) – British mathematician and scientist.
- Jesus of Nazareth (c.5BC – 30 AD) Spiritual teacher and central figure of Christianity.
- Buddha (c 563 – 483 BC) Spiritual Teacher and founder of Buddhism.
- St. Paul (5 – AD 67) – Christian missionary and one of the main writers of the New Testament.
- Ts’ai Lun (AD 50 – 121) Inventor of paper.
- Johann Gutenberg (1395 – 1468) – Inventor of the printing press.
- Christopher Columbus (1451 – 1506) – Italian explorer landed in America.
- Galileo Galilei (1564 – 1642) Italian scientist – confirmed the heliocentric view of the universe.
- Aristotle (384 BC – 322 BC) – Greek philosopher and polymath
- Euclid (c. 325 – 265 BC) – Greek mathematician
- Moses (c 1391 – 1271 BC) A key figure of Jewish / Christian history gave 10 Commandments of Old Testament
- Shih Huang Ti (259-210 BC) – King of the state of Qin who conquered and united different regions of China in 221 BC.
- Augustus Caesar (63 BC – AD 14) – First Emperor of Rome
- Nicolaus Copernicus (1473-1543) Renaissance mathematician and astronomer who believed Sun was the centre of the Universe – rather than earth.
• Antoine Laurent Lavoisier (1743 - 1794) French chemist and biologist who had a leading impact on the chemical revolution.
• Constantine the Great (272 AD - 337) Roman Emperor who accepted Christian religion.
• James Watt (1736 - 1819) Scottish engineer. Watt improved the Newcome steam engine creating an efficient steam engine.
• Michael Faraday (1791 - 1867) - English scientist who contributed in fields of electromagnetism and electrochemistry.
• James Clerk Maxwell (1831-1879) Scottish physicist. Maxwell made a significant contribution to understanding electromagnetism.
• Martin Luther (1483-1546) Sought to reform the Roman Catholic Church - starting the Protestant Reformation.
• George Washington (1732 - 1799) - Leader of US forces during American Revolution and 1st President of US.
• Karl Marx (1818 -1883) - German Communist philosopher.
• Orville and Wilbur Wright Orville (1871 - 1948) - Wilbur (1867 - 1912) - Created and flew the first aeroplane.
• Genghis Kahn (1162 - 1227) - Military and political leader of the Mongols.
• Adam Smith (1723-1790) Scottish social philosopher and pioneer of classical economics.
• William Shakespeare (1564- 1616) English poet and playwright.
• John Dalton (1766 - 1844) English chemist and physicist. Made contributions to atomic theory.
• Alexander the Great (356 - 323 BC) - King of Macedonia and military leader.
• Napoleon Bonaparte (1769 -1821) - French military and political leader.
• Thomas Edison (1847 - 1931) - Inventor and businessman helped introduce electricity and electric light bulbs.
• Antony van Leeuwenhoek (1632-1723) Dutch chemist - founder of microbiology.
• William T.G. Morton (1819 - 1868) American dentist who pioneered the use of anaesthetic.
• **Guglielmo Marconi** (1874 - 1937) Italian engineer who helped develop radio transmission.

• **Adolf Hitler** (1889 - 1945) - Dictator of Nazi Germany.

• **Plato** (424 - 348 BC) - Greek philosopher.

• **Oliver Cromwell** (1599-1658) - Leader of Parliamentarians in English civil war.

• **Alexander Graham Bell** (1847 - 1922) - Scottish inventor of the telephone.

• **Alexander Fleming** (1881-1955) Scottish biologist who discovered penicillin.

• **John Locke** (1632-1704) English political philosopher. Locke promoted a theory of liberal democracy and a social contract.

• **Ludwig van Beethoven** (1770-1827) German composer of the classical and romantic period.

• **Werner Heisenberg** (1901-1976) German theoretical physicist - one of the pioneers of Quantum mechanics

• **Louis Daguerre** (1787-1851) French artist and photographer, who is credited with the invention of the camera.

• **Simon Bolivar** (1783 - 1830) - Liberator of Latin American countries

• **Rene Descartes** (1596 - 1650) French philosopher and mathematician. “I think, therefore I am.”

• **Michelangelo** (1475 - 1564) Renaissance sculptor, painter and architect

• **Pope Urban II** (1042 - 29 July 1099) Influential Pope who ordered the first Crusade to the Holy Land and set up the Papal Court

• **Umar ibn al-Khattab** (584 CE - 644 CE) Powerful Muslim Caliphate and senior companion of Muhammad. An influential figure in Sunni Islam.

• **Asoka** (c. 260 - 232 BC) Powerful Indian King who established large empire by conquest before converting to Buddhism and pursuing a peaceful approach

• **St. Augustine** (354 - 430) Influential Christian saint and writer, who shaped much of Western Christian thought.

• **William Harvey** (1578 - 3 June 1657) English physician who made contributions to understanding how blood circulated in the body.
• Ernest Rutherford (1871 – 1937) NZ born British physicist who made discoveries in atomic physics. His work on splitting the atom was influential for the development of atomic science.

• John Calvin (1509 – 27 May 1564) Christian theologian who developed a strict brand of Protestant Christianity which stressed the doctrine of predestination.

• Gregor Mendel (1822 – 1884) Czech/Austrian scientist and friar – who founded modern science of genetics.

• Max Planck (1858 – 1947) German theoretical physicist who developed a theory of Quantum physics and discovered energy quanta.

• Joseph Lister (1827 – 1912) British surgeon who pioneered the use of sterilisation and antiseptic surgery.

• Nikolaus August Otto (1832 – 1891) German engineer who developed compressed charge internal combustion engine to run on petrol

• Francisco Pizarro (1471 – 1541) Spanish Conquistador who claimed Inca lands for Spain.

• Hernando Cortes (1485 – 1547) Spanish Conquistador who conquered the Aztec lands of modern-day Mexico.

• Thomas Jefferson (1743 – 1826) 3rd President of US. Principle author of the US Declaration of Independence.

• Queen Isabella I (1451 – 1504) Queen of Castille, who helped create a powerful and unified state of Spain whose influence spread to the Americas.

• Joseph Stalin (1878 – 1953) Absolute ruler of the Soviet Union from 1924 to his death. Led the Soviet Union in WWII.

• Julius Caesar (100 BC – 44 BC) Roman ruler who oversaw the demise of the Roman Republic to be replaced with a Roman Emperor. Militarily strengthened the power of Rome.

• William the Conqueror (1028 – 1087) First Norman King of England

• Sigmund Freud (1856 – 1939) An Austrian neurologist who founded psychoanalysis, which involved the investigation of the subconscious, dreams and human mind.

• Edward Jenner (1749 – 1823) Developed the world’s first vaccine (the smallpox vaccine). Known as the father of immunology.

• Wilhelm Conrad Roentgen (1845 – 1923) German physicist who discovered electromagnetic waves or X-rays.
• **Johann Sebastian Bach** (1685 - 1750) Composer and organist who created some of the world’s most beautiful music.

• **Lao Tzu** (6th Century BC - ) Author of Tao Te Ching and founder of Taoism

• **Voltaire** (1694 - 1778). A key figure of European Enlightenment. His satirical writings played a role in the French Revolution.

• **Johannes Kepler** (1571 - 1630) German mathematician and astronomer who created laws of planetary motion.

• **Enrico Fermi** (1901 - 1954) Italian-American physicist who created the first nuclear reactor

• **Leonhard Euler** (1707 - 1783) Swiss mathematician who made prolific discoveries in calculus and graph theory.

• **Jean-Jacques Rousseau** (1712-1778) - French philosopher, author of Social Contract

• **Nicoli Machiavelli** (1469 - 1527) Italian diplomat and Renaissance writer considered the father of political science.

• **Thomas Malthus** (1766 - 1834) English scholar who raised concern over growing population.

• **John F. Kennedy** (1917 - 1963) 38th President of the US. Served at the height of the Cold War and helped defuse Cuban Missile Crisis.

• **Gregory Pincus** (1903 - 1967) American biologist who created the oral contraceptive pill.

• **Mani** (216-274) Iranian founder of Manichaeism, a gnostic religion which for a time was a rival to Christianity.

• **Lenin** (1870 - 1924) Leader of the Russian Revolution and new Communist regime from 1917 to 1924.

• **Sui Wen Ti** (541 - 604) Founder of China’s Sui Dynasty and reunifying China in 589

• **Vasco da Gama** (1460s -1524) Portuguese explorer, first European to reach India and establish a route for imperialism.

• **Cyrus the Great** (600 - 530 BC) Founder of the Achaemenid Empire, the first Persian Empire. Relatively enlightened ruler.

• **Peter the Great** (1721 - 1725) Russian Emperor who expanded the Tsarist Empire to make Russia European power.

• **Francis Bacon** (1561 – 1626) Creator of the scientific method and key figure in Scientific Revolution of the Enlightenment.

• **Henry Ford** (1863 – 1947) Owner of Ford Motor Company. Revolutionised mass-production techniques

• **Mencius** (385-303BC) Chinese philosopher one of the principal interpreters of Confucianism.

• **Zoroaster** (c. 1200 BC) Iranian prophet who founded the religion of Zoroastrianism.

• **Queen Elizabeth I** (1533 – 1603) Queen of England from 1558 to her death in 1603. Cemented England as a Protestant country defeated Spanish Armada.

• **Mikhail Gorbachev** (1931) Leader of Soviet Communist Party who pursued reform – perestroika and glasnost to open Eastern Europe to democracy.

• **Menes** c. 3000 BC Egyptian pharaoh who united Upper and Lower Egypt to found the First Dynasty.

• **Charlemagne** (742 – 814) United Europe to form the Carolingian Empire. First western Emperor since the fall of Rome.

• **Homer** Greek poet who wrote Iliad and Odyssey

• **Justinian I** (482 – 565) Emperor of Eastern Roman Empire

• **Mahavira** (6th century BC) Principal figure of Jainism.

### 100 Most Influential Scientists Who Shaped World History

[1] **Sir Isaac Newton**

**Birth:** Dec. 25, 1642 [Jan. 4, 1643, New Style], Woolsthorpe, Lincolnshire, England

**Death:** March 20 [March 31], 1727, London

**Known for:** the Newtonian Revolution
[2] **Albert Einstein**

**Birth:** March 14, 1879, Ulm, Wurttemberg, Germany

**Death:** April 18, 1955, Princeton, N.J., U.S.

**Known for:** Twentieth-Century Science

[3] **Niels Bohr**

**Birth:** Oct. 7, 1885, Copenhagen, Denmark

**Death:** Nov. 18, 1962, Copenhagen

**Known for:** the Atom

[4] **Charles Darwin**

**Birth:** Feb. 12, 1809, Shrewsbury, Shropshire, England

**Death:** April 19, 1882, Downe, Kent

**Known for:** Evolution

[5] **Louis Pasteur**

**Birth:** Dec. 27, 1822, Dole, France

**Death:** Sept. 28, 1895, Saint-Cloud, near Paris

**Known for:** the Germ Theory of Disease

[6] **Sigmund Freud**
**Carl Jung**

**Birth:** May 6, 1856, Freiberg, Moravia, Austrian Empire [now Přibor, Czech Republic]

**Death:** Sept. 23, 1939, London, England

**Known for:** Psychology of the Unconscious

[7] **Galileo Galilei**

**Birth:** Feb. 15, 1564, Pisa [Italy]

**Death:** Jan. 8, 1642, Arcetri, near Florence

**Known for:** the New Science

[8] **Antoine-Laurent Lavoisier**

**Birth:** Aug. 26, 1743, Paris, France

**Death:** May 8, 1794, Paris

**Known for:** the Revolution in Chemistry

[9] **Johannes Kepler**

**Birth:** Dec. 27, 1571, Weil der Stadt, Wurttemberg [Germany]

**Death:** Nov. 15, 1630, Regensburg

**Known for:** Motion of the Planets

[10] **Nicolaus Copernicus**

**Birth:** Feb. 19, 1473, Toruń, Poland
Death: May 24, 1543, Frauenburg, East Prussia [now Frombork, Poland]

Known for: the Heliocentric Universe


Birth: Sept. 22, 1791, Newington, Surrey, England

Death: Aug. 25, 1867, Hampton Court

Known for: the Classical Field Theory

[12] James Clerk Maxwell

Birth: June 13, 1831, Edinburgh, Scotland

Death: Nov. 5, 1879, Cambridge, Cambridgeshire, England

Known for: the Electromagnetic Field


Birth: July 12, 1813, Saint-Julien

Death: February. 10, 1878, Paris

Known for: the Founding of Modern Physiology

[14] Franz Boas

Birth: July 9, 1858, Minden, Westphalia, Germany

Death: December 21, 1942, New York, U.S
Known for: Modern Anthropology


Birth: December, 1901, Würzburg, Bavaria, German Empire

Death: 1 February 1976, Munich, Bavaria, West Germany

Known for: Quantum Theory

[16] Linus Pauling

Birth: Feb. 28, 1901, Portland, Ore., U.S.

Death: Aug. 19, 1994, Big Sur, California

Known for: Twentieth-Century Chemistry

[17] Erwin Schrödinger

Birth: Aug. 12, 1887, Vienna, Austria

Death: Jan. 4, 1961, Vienna

Known for: Wave Mechanics

[18] John James Audubon

Birth: April 26, 1785, Les Cayes, Saint-Domingue, West Indies [now in Haiti]

Death: Jan. 27, 1851, New York, N.Y., U.S.

Known for: drawings and paintings of North American birds
[19] Ernest Rutherford

**Birth:** Aug. 30, 1871, Spring Grove, N.Z.

**Death:** Oct. 19, 1937, Cambridge, Cambridgeshire, England

**Known for:** the Structure of the Atom

[20] Paul Adrien Maurice Dirac

**Birth:** Aug. 8, 1902, Bristol, Gloucestershire, England

**Death:** Oct. 20, 1984, Tallahassee, Florida, USA

**Known for:** Quantum Electrodynamics

[21] Andreas Vesalius

**Birth:** Dec. 1514, Brussels [now in Belgium]

**Death:** June 1564, island of Zacynthus, Republic of Venice [now in Greece]

**Known for:** the New Anatomy

[22] Tycho Brahe

**Birth:** Dec. 14, 1546, Knudstrup, Scania, Denmark

**Death:** Oct. 24, 1601, Prague

**Known for:** the New Astronomy
[23] Comte de Buffon

Birth: September 07, 1707, Montbard, Burgundy, France

Death: April 16, 1788, Paris, France

Known for: *L'Histoire Naturelle*

[24] Ludwig Boltzmann

Birth: February 20, 1844, Vienna, Austrian Empire (present-day Austria)

Death: September 5, 1906, Tybein near Trieste, Austria-Hungary [present-day Duino, Italy]

Known for: Thermodynamics


Birth: April 23, 1858, Kiel, Schleswig [Germany]

Death: Oct. 4, 1947, Göttingen, West Germany

Known for: the Quanta

[26] Marie Curie

Birth: Nov. 7, 1867, Warsaw, Poland, Russian Empire

Death: July 4, 1934, near Sallanches, France

Known for: Radioactivity

[27] Sir William Herschel
Charles Lyell
Birth: Nov. 14, 1797, Kinnordy, Forfarshire, Scotland
Known for: Modern Geology

Pierre Simon de Laplace
Birth: March 23, 1749, Beaumount-en-Auge, Normandy, France
Death: March 5, 1827, Paris
Known for: Black hole, Nebular hypothesis of the origin of the solar system

Edwin Powell Hubble
Birth: Nov. 20, 1889, Marshfield, Mo., U.S.
Death: Sept. 28, 1953, San Marino, California
Known for: Extragalactic astronomy

Joseph J. Thomson
Birth: December 18, 1856, Cheetham Hill, Manchester, Lancashire, England, United Kingdom
Death: August 30, 1940, Cambridge, Cambridgeshire, England, UK

Known for: the Discovery of the Electron

[32] Max Born

Birth: December 11, 1882, Breslau, German Empire

Death: January 5, 1970, Göttingen, West Germany

Known for: Quantum Mechanics

[33] Francis Harry Compton Crick

Birth: June 8, 1916, Northampton, Northamptonshire, England

Death: July 28, 2004, San Diego, Calif., U.S.

Known for: Molecular Biology

[34] Enrico Fermi

Birth: Sept. 29, 1901, Rome, Italy

Death: Nov. 28, 1954, Chicago, Ill., U.S.

Known for: Statistical mechanics

[35] Leonhard Euler

Birth: April 15, 1707, Basel, Switzerland

Death: September 18, 1783, Saint Petersburg, Russian Empire
Known for: Eighteenth-Century Mathematics

[36] Justus Liebig

Birth: May 12, 1803, Darmstadt, Grand Duchy of Hesse

Death: April 18, 1873, Munich, German Empire

Known for: Nineteenth-Century Chemistry

[37] Arthur Stanley Eddington

Birth: December 28, 1882, Kendal, Westmorland, England

Death: November 22, 1944, Cambridge, Cambridgeshire, England

Known for: Modern astronomy

[38] William Harvey

Birth: April 1, 1578, Folkestone, Kent, England

Death: June 3, 1657, London

Known for: Circulation of the Blood

[39] Marcello Malpighi

Birth: 1628

Death: 1694

Known for: Microscopic Anatomy
[40] Christiaan Huygens

Birth: 1629

Death: 1695

Known for: the Wave Theory of Light

[41] Johann Carl Friedrich Gauss

Birth: April 30, 1777, Brunswick, Duchy of Brunswick-Wolfenbüttel, Holy Roman Empire

Death: February 23, 1855, Göttingen, Kingdom of Hanover

Known for: Number theory, algebra, statistics, analysis, differential geometry, geodesy, geophysics, mechanics, electrostatics, astronomy, matrix theory & optics

[42] Albrecht von Haller

Birth: October 16, 1708, Bern, Swiss Confederacy

Death: December 12, 1777, Bern, Swiss Confederacy

Known for: Eighteenth-Century Medicine

[43] Friedrich August Kekule von Stradonitz

Birth: September 7, 1829, Darmstadt, Grand Duchy of Hesse

Death: July 13, 1896, Bonn, German Empire

Known for: Theory of chemical structure, tetravalence of carbon, structure of benzene
[44] Robert Koch

**Birth:** Dec. 11, 1843, Clausthal, Hannover [now Clausthal-Zellerfeld, Germany]

**Death:** May 27, 1910, Baden-Baden, Germany

**Known for:** Bacteriology

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[45] Murray Gell-Mann

**Birth:** September 15, 1929, Manhattan, New York City, United States

**Known for:** Gell-Mann and Low theorem, Elementary particles, quarks, Gell-Mann matrices

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[46] Hermann Emil Louis Fischer

**Birth:** October 09, 1852, Euskirchen, Rhine Province

**Death:** July 15, 1919, Berlin, Germany

**Known for:** Organic Chemistry

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[47] Dmitri Mendeleev

**Birth:** Jan. 27 [Feb. 8, New Style], 1834, Tobolsk, Siberia, Russian Empire

**Death:** Jan. 20 [Feb. 2], 1907, St. Petersburg, Russia

**Known for:** the Periodic Table of Elements

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[48] Sheldon Glashow
Birth: December 5, 1932, New York City, New York, USA

Known for: Electroweak theory & Georgi–Glashow model


Birth: April 6, 1928, Chicago, Illinois, U.S

Known for: the Structure of DNA

[50] John Bardeen

Birth: May 23, 1908, Madison, Wisconsin, U.S
Death: Jan. 30, 1991, Boston, Massachusetts, U.S

Known for: Superconductivity & BCS theory

[51] John von Neumann

Birth: December 28, 1903, Budapest, Austria-Hungary
Death: February 8, 1957, Walter Reed General Hospital Washington, D.C.

Known for: the Modern Computer

[52] Richard P. Feynman

Birth: May 11, 1918, New York, N.Y., U.S.
Death: Feb. 15, 1988, Los Angeles, California

Known for: Quantum Electrodynamics

1674
[53] Alfred Lothar Wegener

Birth: Nov. 1, 1880, Berlin, Germany

Death: Nov. 1930, Greenland

Known for: Continental Drift

[54] Stephen W. Hawking

Birth: Jan. 8, 1942, Oxford, Oxfordshire, England

Known for: Quantum Cosmology

[55] Antonie van Leeuwenhoek


Death: Aug. 26, 1723, Delft

Known for: the Simple Microscope

[56] Max von Laue

Birth: Oct. 09, 1879, Pfaffendorf, Kingdom of Prussia, German Empire

Death: April 24, 1960, West Berlin

Known for: X-ray Crystallography

[57] Gustav Kirchhoff
**Birth:** March 12, 1824, Königsberg, Kingdom of Prussia [present-day Russia]

**Death:** October 17, 1887, Berlin, Prussia, German Empire [present-day Germany]

**Known for:** Kirchhoff's circuit laws, Kirchhoff's laws of spectroscopy, Kirchhoff's law of thermochemistry & Kirchhoff's law of thermal radiation

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[58] **Hans Bethe**

**Birth:** July 2, 1906, Strassburg, Ger. [now Strasbourg, France]

**Death:** March 6, 2005, Ithaca, N.Y., U.S.

**Known for:** the Energy of the Sun

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[59] **Euclid**

**Known for:** the Foundations of Mathematics

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[60] **Gregor Mendel**

**Birth:** July 22, 1822, Heinzendorf, Austria [now Hynčice, Czech Rep.]

**Death:** Jan. 6, 1884, Brünn, Austria-Hungary [now Brno, Czech Rep.]

**Known for:** the Laws of Inheritance

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[61] **Heike Kamerlingh Onnes**

**Birth:** September 21, 1853, Groningen, Netherlands

**Death:** February 21, 1926, Leiden, Netherlands
Known for: Superconductivity, Onnes-effect & Virial Equation of State

[62] Thomas Hunt Morgan

Birth: September 25, 1866, Lexington, Kentucky
Death: December 04, 1945, Pasadena, California
Known for: the Chromosomal Theory of Heredity

[63] Hermann von Helmholtz

Birth: August 31, 1821, Potsdam, Kingdom of Prussia
Death: September 08, 1894, Charlottenburg, German Empire
Known for: the Rise of German Science

[64] Paul Ehrlich

Birth: March 14, 1854, Strehlen, Lower Silesia, German Kingdom of Prussia
Death: August 20, 1915, Bad Homburg, Hesse, Germany
Known for: Chemotherapy

[65] Ernst Walter Mayr

Birth: July 05, 1904, Kempten, Germany
Death: February 03, 2005, Bedford, Massachusetts, United States
Known for: Evolutionary Theory
[66] Theodosius Grygorovych Dobzhansky

Birth: January 25, 1900, Nemyriv, Russian Empire

Death: December 18, 1975, San Jacinto, California, United States

Known for: the Modern Synthesis

[67] Max Ludwig Henning Delbrück

Birth: September 04, 1906, Berlin, German Empire

Death: March 9, 1981, Pasadena, California, United States

Known for: the Bacteriophage

[68] Charles Scott Sherrington

Birth: November 27, 1857, Islington, Middlesex, England

Death: March 04, 1952, Eastbourne, Sussex, England

Known for: Neurophysiology

[69] Jean Baptiste Lamarck

Birth: August 01, 1744, Bazentin, Picardy, France

Death: December 18, 1829, Paris, France

Known for: the Foundations of Biology
[70] William Bayliss

Birth: May 2, 1860, Wednesbury, Staffordshire, England

Death: August 27, 1924, London, England

Known for: Modern Physiology

[71] John Dalton

Birth: Sept. 5 or 6, 1766, Eaglesfield, Cumberland, England

Death: July 27, 1844, Manchester

Known for: the Theory of the Atom

[72] Frederick Sanger

Birth: August 13, 1918, Rendcomb, Gloucestershire, England

Death: November 19, 2013, Cambridge, Cambridgeshire, England

Known for: the Genetic Code

[73] Louis Victor de Broglie

Birth: August 15, 1892, Dieppe, France

Death: March 19, 1987, Louveciennes, France

Known for: Wave/Particle Duality

[74] Carl Linnaeus
Birth: May 23, 1707, Råshult, Stenbrohult parish (now within Älmhult Municipality), Sweden

Death: January 10, 1778, Hammarby (estate), Danmark parish (outside Uppsala), Sweden

Known for: the Binomial Nomenclature

[75] J. Robert Oppenheimer

Birth: April 22, 1904, New York, N.Y., U.S.


Known for: the Atomic Era

[76] Sir Alexander Fleming

Birth: Aug. 6, 1881, Lochfield Farm, Darvel, Ayrshire, Scotland


Known for: Penicillin

[77] Jonas Edward Salk

Birth: October 28, 1914, New York

Death: June 23, 1995, La Jolla, California, United States

Known for: Vaccination

[78] Robert Boyle

Birth: Jan. 25, 1627, Lismore Castle, County Waterford, Ireland

Known for: **Boyle's law**

[79] **Francis Galton**

Birth: Feb. 16, 1822, near Sparkbrook, Birmingham, Warwickshire, England

Death: Jan. 17, 1911, Grayshott House, Haslemere, Surrey

Known for: **Eugenics**

[80] **Joseph Priestley**

Birth: March 13, 1733, Birstall Fieldhead, near Leeds, Yorkshire [now West Yorkshire], England

Death: Feb. 6, 1804, Northumberland, Pa., U.S.

Known for: Discovery of **oxygen**

[81] **Hippocrates**

Known for: Medicine

[82] **Pythagoras**

Known for: **Pythagorean Theorem**

[83] **Benjamin Franklin**

Birth: January 17, 1706, Boston, Massachusetts Bay, British America
Death: April 17, 1790, Philadelphia, Pennsylvania, U.S.

Known for: Electricity

[84] Leonardo da Vinci

Birth: April 15, 1452, Anchiano, near Vinci, Republic of Florence [now in Italy]

Death: May 2, 1519, Cloux [now Clos-Luce], France

Known for: Mechanics and Cosmology

[85] Ptolemy

Known for: Greco-Roman science


Birth: Dec. 6, 1778, Saint-Léonard-de-Noblat, France

Death: May 9, 1850, Paris

Known for: Behavior of gases

[87] Archimedes

Known for: the Beginning of Science

[88] Sir Fred Hoyle

Birth: June 24, 1915, Bingley, Yorkshire [now West Yorkshire], England
Death: Aug. 20, 2001, Bournemouth, Dorset

Known for: Stellar nucleosynthesis

[89] Norman Ernest Borlaug

Birth: March 25, 1914, Cresco, Iowa, U.S.

Known for: Green revolution

[90] Amedeo Avogadro

Birth: Aug. 9, 1776, Turin, in the Kingdom of Sardinia and Piedmont

Death: July 9, 1856, Turin, Italy

Known for: Molecular Hypothesis of Combining Gases

[91] Luis W. Alvarez

Birth: June 13, 1911, San Francisco, Calif., U.S.

Death: Sept. 1, 1988, Berkeley, California

Known for: discovery of many resonance particles (subatomic particles having extremely short lifetimes and occurring only in high-energy nuclear collisions)

[92] George Gamow

Birth: March 4, 1904, Odessa, Russian Empire [now in Ukraine]

**Known for:** Big Bang Hypothesis

[93] **Francis Collins**

**Birth:** April 14, 1950, Staunton, Va., U.S.

**Known for:** Human Genome Project

[94] **Albert Abraham Michelson**

**Birth:** Dec. 19, 1852, Strelno, Prussia [now Strzelno, Pol.]

**Death:** May 9, 1931, Pasadena, Calif., U.S.

**Known for:** Establishment of the speed of light as a fundamental Constant

[95] **Rachel Carson**

**Birth:** May 27, 1907, Springdale, Pa., U.S.

**Death:** April 14, 1964, Silver Spring, Md.

**Known for:** Environmental pollution and the natural history of the sea

[96] **Joseph Lister**

**Birth:** April 5, 1827, Upton, Essex, England

**Death:** Feb. 10, 1912, Walmer, Kent

**Known for:** antiseptic medicine
[97] **Louis Agassiz**

**Birth:** May 28, 1807, Motier, Switz.

**Death:** Dec. 14, 1873, Cambridge, Mass., U.S.

**Known for:** Natural science

[98] **André-Marie Ampère**

**Birth:** Jan. 22, 1775, Lyon, France

**Death:** June 10, 1836, Marseille

**Known for:** Electrodynamics

[99] **Paracelsus**

**Birth:** Nov. 11 or Dec. 17, 1493, Einsiedeln, Switzerland

**Death:** Sept. 24, 1541, Salzburg, Archbishopric of Salzburg [now in Austria]

**Known for:** Der grosse Wundartzney ("Great Surgery Book")

[100] **Edward O. Wilson**

**Birth:** April 15, 1452, Anchiano, near Vinci, Republic of Florence [now in Italy]

**Death:** June 10, 1929, Birmingham, Ala., U.S.

**Known for:** Sociobiology